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Stabilization Investigation

Former CIBA-GEIGY Facility
Cranston, Rhode Island



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Revised Final Stabilization Design Documents Technical Specifications

Prepared For:
CIBA-GEIGY Corporation
Route 37 West
Toms River, New Jersey 08754

Prepared By:
Woodward-Clyde Consultants
201 Willowbrook Boulevard
Wayne, New Jersey 07470

Volume 2B of 4

January 1995
Project No. 87X4660D

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SECTION 13120
PRE-ENGINEERED BUILDINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Modular, insulated metal wall and roof panel systems for the recovery wells.

1.2 REFERENCES

- A. ASTM C-177.
- B. ASTM E-84.

1.3 SYSTEM DESCRIPTION

- A. Clear span, modular construction of structural, insulated sandwich panel for the roof and walls.
- B. Roof slope: flat.
- C. Assembly: Free of rattles, racking, thermal stress creaking, and wind whistles.

1.4 DESIGN REQUIREMENTS

- A. Thermal Resistance of Wall System: maximum R value of 34.
- B. Thermal Resistant of Roof System: maximum R value of 34.
- C. Members shall withstand dead load, snow load and wind loads calculated in accordance with Basic National Building Code (BOCA), latest edition and local and state amendments.
- D. Exterior wall and roof system to withstand imposed loads with maximum allowable deflection of span = 1/180.
- E. Assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 120 degrees F.
- F. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

1.5 SUBMITTALS

- A. Product Data: Provide assembly dimensions, locations, connections, attachments and openings.
- B. Provide wall and roof system dimensions; panel layout; general construction detail; anchorages and method of anchorage; and method of installation.
- C. Provide anchor bolt settings, sizes and locations.
- D. Manufacturer's Installation Instructions: Provide preparation requirements and assembly sequence.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified under this Section with minimum three years documented experience.
- B. Modular system shall meet minimum dead and live load requirements in accordance with New Jersey's Uniform Construction Code, and shall be approved by a professional engineer experienced in the design of this Work and licensed in the State of New Jersey.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for submission of design calculations and as required for acquiring permit.
- B. Cooperate with regulatory agency or authority and provide all data as requested.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

1.9 WARRANTY

- A. Provide ten (10) year warranty of any part against defects in materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS - BUILDING SYSTEM

- A. Modular System by Bally Engineered Structures, Inc., Bally, PA (215)845-2311.
- B. Or equal.

2.2 MATERIALS - WALL AND ROOF SYSTEM

- A. Insulation: Urethane foam core classified by Underwriters Laboratories as having flame spread of 25 or lower and smoke generation of less than 450 in accordance with ASTM E-84-76. Panels shall also be approved by Factory Mutual as Class I building type.
- B. Panels shall consist of interior and exterior metal skins formed with steel dies and roll-forming equipment and checked with gauges for uniformity and accuracy. Metal skins shall be placed into steel molds and liquid urethane injected between them. For extra rigidity, the exteriors of all vertical panels, except corners, shall have vertical grooves spaced on 5-3/4 inch centers. Urethane shall be foamed-in-place and when completely heat-cured shall bond to the metal skins to form a rigid 4-inch or 5-inch insulated panel. The insulation must retain dimensional stability in an operating temperature range of 90 degrees F to 250 degrees F dry heat. Panels shall be 100 percent urethane insulation. To insure tight joints, panel edges must have foamed-in-place tongues and grooves with flexible vinyl gasket also foamed-in-place on the interior and exterior of all tongue edges. Gaskets shall be resistant to damage from oil, fats, water, detergents, sunlight, and contaminated groundwater.
- C. All panels except corner panels shall be made in 23 inch and 46 inch widths, and shall be fully interchangeable for easy assembly. Panels 11-1/2 inches and 34-1/2 inches wide are to be furnished only when required to fit the allocated space. To assure correct alignment and maximum strength, corner panels shall be 90 degree angles with exterior horizontal dimensions of 12 inches on each side.
- D. Wall Anchors: Shall be supplied by the manufacturer and shall be proved to be adequate in size and number by Engineering calculations.
- E. Shelter outside dimensions shall match the outside dimensions of the foundation wall and "Z" base drip edges shall be supplied by the manufacturer to prevent water damage to the base of the panel.

- F. Panels shall be equipped with Bally "Speed Lok" joining devices. Distance between locks shall not exceed 46 inches. Each locking device shall consist of a cam-action, hooked locking arm of a replaceable type placed in one panel and a steel rod positioned in the adjoining panel, so that when the locking arm is rotated, the hook engages over the rod and draws the panels tightly together with cam-action. The locking arms and steel rods shall be housed in individual steel pockets set into the panel. Pockets on one side of the panel shall be connected to pockets on the other side, in width, by the use of 2 inch wide steel straps set into the insulation. When panels are joined together, these straps shall form "perimeters of steel," with lock-to-lock connections for extra strength. An aligning device shall be provided in at least one "Speed-Lock" pocket for every vertical panel. Press-fit caps shall be provided to close wrench holes. The required locking wrench shall be supplied.
- G. Exterior Finish: .026 galvanized steel with sand tan polyester painted finish.
- H. Interior finish: .026 galvanized steel with white polyester painted finish.
- I. Roof: Shall be of similar construction as the walls, with a weatherproof .038 inch stucco-embossed aluminum outer finish.
- J. Gutters and downspouts shall be provided by the building manufacturer as shown.

2.3 METAL DOORS AND FRAMES

- A. Doors shall be 2 inch steel faced security doors with full urethane insulation core. Doors shall be supplied with weatherstripping and wiper gasket.
- B. Jambs shall be heavy gage steel and sized to screw to building wall panels.
- C. Entrance shall be a double leaf door without center post with clean opening of 72 inches by 84 inches.
- D. Hardware for doors shall be Marks Model #2032ASP26D cylindrical lockset with satin stainless steel finish.
- E. Door hinges shall be SOSS 450 tamperproof pinned butt hinges. Three hinges per door.
- F. Weatherproof shields shall be installed above doors to divert rain and snow.
- G. Sillplate shall be extruded aluminum plate.

2.4 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts of standard profile and size to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that foundation, floor slab, mechanical devices, electrical utilities, and anchors are installed as shown and specified.

3.2 ERECTION - WALL AND ROOFING SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Install sealant and gaskets to prevent weather penetration.

3.3 ERECTION - GUTTER AND DOWNSPOUT

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Apply bituminous paint on surfaces in contact with cementitious materials.
- C. Slope gutters minimum 1/16 inch/foot.

3.4 INSTALLATION - ACCESSORIES

- A. Install door frame and door in accordance with manufacturer's instruction.
- B. Seal wall and roof accessories watertight and weather tight with sealant recommended by the building manufacturer.

3.5 TOLERANCES

- A. Siding and Roofing: 1/8 inch (3 mm) from line and plumb over building height.

END OF SECTION 13120

SECTION 13121
SVE SYSTEM PROCESS TRAILER AND APPURTENANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop reconditioned and modified process equipment shelter (trailer).
- B. Exterior doors, wood stairs, louvers, interior lighting, heating, air supply and exhaust ventilation, partition wall, and foundation requirements.

1.2 RELATED SECTIONS

- A. Section 11340 - Soil Vapor Extraction System Equipment.

1.3 REFERENCES

- A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.
- B. APA: American Plywood Association.
- C. Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.
- D. UL 305 - Panic Hardware.

1.4 SVE SYSTEM PROCESS TRAILER

- A. A reconditioned 40 x 8-foot box trailer will be required to house major SVE process equipment and will be located at SWMU-11 as shown on the contract drawings. The trailer will be placed and anchored onto foundation supports to prevent movement. The foundation will be constructed such that stormwater can flow underneath the trailer. The trailer will require internal modifications, such as additional exterior doorways, interior partition wall with door, noise insulation, lighting, heating, ventilation, and equipment installation. The exterior of the trailer must have a clean, neat appearance, including a fresh coat of paint.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data describing design characteristics, materials, and finishes.
- C. Shop Drawings: Indicate assembly dimensions, materials, exact position of access doors, stairs, and barrier wall. Indicate louver layout plan and elevations, opening

and clearance dimensions, and tolerances.

- D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and rough in dimensions.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01730.
- B. Operation and Maintenance Data: Include data on start-up, troubleshooting, and operating hardware, cleaning and lubrication requirements, and inspection procedures related to preventative maintenance.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for closing operable louvers in conjunction with the fire and smoke alarm system.
- B. Conform to applicable code for fire rated access units and fire retardant requirements.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
- D. Cooperate with regulatory agency or authority and provide data as requested.

1.8 COORDINATION

- A. Coordinate work under provisions of Section 01040.
- B. Coordinate the work with installation of mechanical ductwork and electrical service to motorized devices.
- C. Coordinate the work with plumbing, electrical, rough-in, and installation of associated and adjacent components.

1.9 WARRANTY

- A. Provide a five-year warranty to include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

- B. Provide three-year warranty for barrier wall.
- C. Warranty: Include coverage of installed sealant and sheet materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01610.

1.11 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Drawings.

1.12 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of 01750.

PART 2 PRODUCTS

2.1 EQUIPMENT SHELTER (TRAILER)

- A. The reconditioned trailer must be sturdy and clean. All advertising and identification will be removed or permanently covered and the entire exterior shall be painted so the trailer will have a clean, neat appearance. The trailer roof and walls shall be leak-free.

- B. The internal dimensions of the trailer shall meet the following requirements:

Internal Length $\geq 39'0"$
 Internal Width $\geq 7'3\text{-}1/2"$
 Internal Height $\geq 8'10"$
 (Ceiling Height)

- C. Access

The process trailer doors (or roll-up) will be secured closed after the major equipment has been installed. This closure will be semi-permanent such that at a future date the access could be opened in the event process equipment must be removed and/or replaced. Carriage bolts through angle-iron or wooden blocking is acceptable. Two steel, insulated exterior doors must be added to the trailer for regular access and emergency exit. Both exterior doors shall be constructed with 16 gauge steel frames and flanges and insulated steel paneled doors. The emergency exit door will have an emergency exit push bar. The access door will have a rugged external locking mechanism used to secure the unmanned trailer,

which can be disabled/disengaged/removed such that operator lock-in can be prevented. The access door will have a stairway and landing. The emergency exit requires a stairway only. Provide OSHA handrails as required.

D. Interior Partition Wall

The trailer will be partitioned into hazardous and non-hazardous zones with the addition of a wall and door. The wall will be tightly fitted and sealed with caulking or sealer to the trailer floor, walls and ceiling. The door will be plain, rugged, and will be gasket-sealed around all edges. The partition wall will be insulated and rough-finished with dry wall on both sides. This wall will prevent the ingress of potentially hazardous vapors from the VES treatment area into the positive (supply) air pressure in the controls space provide an additional safety factor as well as cooling and ventilation. The entire wall system shall be designed to withstand a minimum >8psf distributed load normal to the wall's surface due to the differential pressure generated by the air supply and exhaust ventilation fans.

The partition wall can be constructed of wood or steel studs and plates and covered with plywood and dry-wall or dry-wall only, provided wall system load requirements have been met.

E. Air Supply Ventilator

An air supply ventilator (Dayton Electric, as supplied by W. W. Grainger, Inc., P/N 3C405 or equal) will be installed in the power supply/control section of the trailer to provide a positive ventilation pressure at all times during system operation. It shall be suitably mounted on the roof of the trailer (with mounting curb) to pressurize and ventilate the electrical distribution/controls area of the trailer. It shall be rated to provide a minimum air flow of 1600 CFM at zero pressure, 850 CFM at 0.375-inch pressure.

F. Air Exhaust Ventilator/Intake Louver

An explosion-proof roof ventilator shall be installed on the trailer roof above the VES blower system, using an appropriate curb. The ventilator (McMaster-Carr Model 2207K42 or equal) will produce 2000 CFM at 0.25-inch static pressure minimum. Two 20- x 14-inch air intake louvers (McMaster Carr Model 2039K2 or equal) shall be installed through the trailer floor in a location as shown on the contract drawings.

G. Lighting

Eight (8) explosion-proof lighting fixtures fitted with 100 watt bulbs shall be installed along the peripheral length of the trailer walls on staggered centers, within 8 inches of the ceiling. The lighting circuit extends from the non-hazardous area into a potentially hazardous Class I, Division 2, area, and the electrical conduit

should be sealed and connected accordingly.

H. Heating

One (1) explosion-proof (McMaster Carr P/N 1752K21 or equal) (Class I, Group D hazardous locations) 1800-watt heater shall be installed in the VES process area complete with thermostat. The main function of this heater is freeze protection. The thermostat can be set to energize the heater at 45°F (initial setting).

One (1) 1500-watt baseboard heater with thermostat (McMaster Carr P/N 1778K34 or equal) shall be installed in the electrical distribution/control area of the trailer. The thermostat setting shall be operator's preference.

I. Foundation

The process trailer will be supported at each corner and mid-section by concrete piers and wood blocking as shown on the contract drawings. As a minimum, the top of the pier will be 12 inches by 12 inches, and the base will be 18 inches by 18 inches. Two poured concrete anchors, minimum 12-inch-diameter depth of local frost will be set into the ground in line with the piers at each end and the centerline of the trailer. The trailer will be securely fastened to the anchors using heavy U-bolts, chain, and turnbuckles. Each component of this fastening system will be rated for a minimum working load of 6,000 pounds, and shall be arranged for maximum strength. Concrete shall have a minimum 28-day compressive strength of 3,000 psi.

The trailer should be temporarily placed into position to locate the anchor points and align the pier locations, and to verify the trailer interface details. When the anchors and trailer fastening hardware have been prepared, the process trailer can be rolled into position, disconnected, blocked level, and securely fastened into place. Once everything is secure, the trailer wheels should be removed and placed in storage.

J. Fire Extinguisher

Provide one (1) 20 B:C rated fire extinguisher and mount on partition wall adjacent to doorway on the VES treatment area side (Hazardous Area).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared and rough openings are ready to receive work and opening dimensions are as instructed by the ventilator, door, and louver manufacturers.
- B. Verify that piers and placed anchors are in correct position.

- C. Verify electrical and building items affecting work of this section are placed and ready to receive this work.
- D. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION - PROCESS EQUIPMENT

- A. Install 15 days after date fixed in Owner-Contractor Agreement.

3.3 INSTALLATION - LOUVERS

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louvers in opening framing with exposed fasteners.
- E. Install bird and insect screen and frame to exterior of louver.
- F. Adjust and clean work.
- G. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.4 INSTALLATION - ACCESS DOORS

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in opening. Secure rigidly in place.

3.5 INSTALLATION - BARRIER WALL

- A. Construct framing members full length without splices.
- B. Set and secure materials and components in place, plumb and level.
- C. Secure wall sheathing and or drywall with long dimension perpendicular to wall studs, with ends over firm bearing.
- D. Calk all trailer and door frame interfaces with sealant to ensure complete seal.

END OF SECTION 13121

SECTION 13200
SVE SHOP FABRICATED TANKS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vapor, Vacuum and Water Extraction Tanks.

1.2 RELATED SECTIONS

- A. Section 11340 - Soil Vapor Extraction Equipment.
- B. Section 09900 - Painting.

1.3 REFERENCES

- A. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, "Pressure Vessels".

1.4 SYSTEM DESCRIPTION

As required for separation of vapor and liquid phases from six (6) extraction wells as part of the Soil Vapor Extraction system process, a quantity of one (1) Vapor Extraction Tank (120 gallon nominal capacity) and one (1) Groundwater Extraction Tank (120 gallon nominal capacity) will be required. The vapor extraction tank will serve to remove entrained liquids from the extracted soil vapor stream prior to delivery of vapors to the Vacuum Blower and Vapor Phase Treatment System and shall be equipped with controls to provide for the automatic removal of separated liquids. The Water Extraction Tank will serve as a hydropneumatic vacuum storage tank and will maintain a steady vacuum pressure to the groundwater extraction straws as well as provide draw capacity for the groundwater extraction pump system. The water extraction tank shall be equipped with controls to provide for automatic pressure and liquid level regulation.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide manufacturer data including but not limited to Operation and Maintenance instructions, coating and compatibility data.

- C. Manufacturer's Installation Instructions: Indicate special procedures for assembly and testing of tanks and components.
- D. Form U-1A "Manufacturer's Data Report for Pressure Vessels" certifying conformance to ASME Boiler and Pressure Vessel Code.

1.6 DESIGN REQUIREMENTS

- A. Tanks shall be shop fabricated and furnished with all fittings and features as specified.
- B. All tanks shall have suitable lifting lugs for handling and placement in intended installed orientation.
- C. All Tanks shall have prefabricated structural steel legs with pre-drilled mounting plates for vertical installation.

D. PERFORMANCE:

Capacity: Vapor Vacuum and Water Extraction Tank - 120 gallons (nominal).

Type: Vapor Vacuum and Water Extraction Tank - Vertical, Cylindrical, ASTM, ASME Code, exterior Dished Heads (Top and Bottom) with removable, flanged, top head. Designed for vacuum service (Vapor Vacuum Tank = 0-15 inches Hg, Water Extraction Tank = 0-Full Vacuum) in conformance with the design methods, manufacturing procedures and testing requirements of ASME Boiler and Pressure Vessel Code.

Material: Carbon Steel

Operating Temperature Range: 0° to 140°F

E. Fitting Schedules:

1. VAPOR VACUUM TANK

Quantity	Nom. Diameter (Inches)	Type	Location
1	8	Flanged Fitting	Lower tank shell, Tangential (C.C. direction)
1	6	Flanged Fitting with 18" internal drop tube	Top Head, axially centered.
2	1	Screwed Fitting	Top Head, Vertical.
1	1	Screwed Fitting	Bottom Head, axially centered.
1	1½	Screwed Fitting	Lower Tank Shell
2	1	Screwed Fitting	Lower Tank Shell

2. WATER EXTRACTION TANK

Quantity	Nom. Diameter (inches)	Type	Location
1	2	Flanged Fitting	Upper tank shell
4	1	Screwed Fitting	Top Head, Vertical
1	2	Flanged Fitting	Bottom Head, axially centered..
1	1½	Screwed Fitting	Lower Shell

PART 2 PRODUCTS

2.1 MANUFACTURER/DISTRIBUTOR

- A. Stoystown Tank & Steel Co., Inc./The John Wood Co., Valley Forge, Pennsylvania or Equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install and Test in accordance with the manufacturer's instructions as well as ASME requirements.

END OF SECTION

SECTION 13201

GROUNDWATER PRETREATMENT SYSTEM STAINLESS STEEL TANKS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Design, fabricate, deliver, erect, and test the required stainless steel tanks for the groundwater pretreatment system as shown and specified.

1.2 RELATED SECTIONS

- 1. Division 15, Piping.

1.3 QUALITY ASSURANCE

A. Reference Standards:

- 1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - a. AWWA ASTM A-36, Standard for Welded Stainless Steel Tanks.
 - b. OSHA

1.4 SUBMITTALS

A. Shop Drawings:

- 1. Submit for approval the following:
 - a. Copies of detailed tank drawings. Drawings shall include all dimensions, sizes, plate thicknesses, anchorage, and piping details and

details of all required accessories. Use welding symbols recommended by American Welding Society.

PART 2 PRODUCTS

2.1 TANKS

A. Equalization Tank:

1. Diameter: 9'-0"
2. Sidewall Height: 13'-0"
3. Nominal Capacity: 6,000 gallons
4. Tank Geometry: Flat bottom, closed top,
5. Nozzles (150 lb flanges):
 - a. Groundwater Inlet: 4-inch
 - b. SVE Inlet: 3-inch
 - c. Air Exhaust: 6-inch on top
 - d. Outlet: 6-inch on tank sidewall
6. Manway: 24" diameter on top
7. Solution pH: 6-10
8. Temperature: Ambient

9. Solution SG: 1.05
10. Tank Drain: 2-inch
11. Spare Nozzles: 4-inch (2 on top, 2 on sidewall)
12. Materials: 316 Stainless Steel

B. Final pH Adjustment Tank:

1. Diameter: 8'-0"
2. Sidewall Height: 9'-0"
3. Nominal Capacity: 3,000 gallons
4. Tank Geometry: Flat bottom
5. Baffles:
 - a. Number: 3
 - b. Size: 1/12 (Tank Dia.)
 - c. Separation: 120°
6. Nozzles:
 - a. Inlet: 4-inch on tank sidewall
 - b. Outlet: 4-inch on tank sidewall
 - c. Mixer: 6-inch
 - d. pH probe: 4-inch on top

- e. Tank Drain: 2-inch
- 7. Solution pH: 6-10
- 8. Temperature: Ambient
- 9. Solution SG: 1.05
- 10. Mixer Support Bridge
- 11. Spare Nozzle: 4-inch (2 on top, 2 on sidewall)
- 12. Materials: 316 Stainless Steel
- C. Backwash Tank:
 - 1. Diameter: 11'-0"
 - 2. Sidewall Height: 14'-0"
 - 3. Nominal Capacity: 10,000 gallons
 - 4. Tank Geometry: Cone bottom, closed top, vertical
 - 5. Nozzles:
 - a. Inlet: 6-inch on tank top
 - b. Air Exhaust: 6-inch on tank top
 - c. Drain: 4-inch on cone
 - d. Sludge Taps: (4) 2-inch on cone

6. Manway: 24-inch diameter on top
7. Solution pH: 8-10
8. Temperature: Ambient
9. Solution SG: 1.05
10. Cone Angle (minimum): 45°
11. Spare Nozzles: 4-inch (2 on top, 2 on sidewall)
12. Materials: 316 Stainless Steel

D. Free-Product Storage Tank:

1. Diameter: 6'-0"
2. Sidewall Height: 5'-0"
3. Nominal Capacity: 1,000 Gallons
4. Tank Geometry: Cone Bottom, Closed Top, Vertical
5. Nozzles
 - a. Inlet: 2-inch
 - b. Air Exhaust: 4-inch
 - c. Drain: 2-inch
6. Influent pH: 6-10

7. Temperature: Ambient

8. Solution SG: <1.0

9. Cone Angle: 45°

10. Materials: 316 Stainless Steel

E. Minimum Steel Thickness:

1. The minimum thickness of any part of tank structure, shall be the larger of the following:

a. Stainless steel sheet shall be a minimum yield strength of 33,000 psi. Minimum thickness shall be 12 gauge.

b. Stainless steel plate shall have a minimum yield strength of 36,000 psi.

2.2 ACCESSORIES

A. Provide the following accessories for each tank.

1. Ladder:

a. Provide one steel ladder for each tank as shown and specified.

B. Mixer Bridge Support:

1. Provide a bridge support designed to carry the load, bonding moment and torque of the mixing equipment for the final pH tank.

PART 3 EXECUTION

3.1 GENERAL

- A. Install all stainless steel tanks in accordance with the manufacturers/suppliers recommendations.

END OF SECTION 13201

SECTION 13410

GENERAL INSTRUMENTATION AND CONTROL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation of:

1. Sensors and transmitters.
2. Instrumentation tubing, wiring and conduits.
3. Control panels.
4. Field wiring terminations within the control panels.
5. Cabling and termination devices for the Programmable Logic Controllers (PLC) area network.

B. Validation, operational testing, and training.

1.02 SYSTEM RESPONSIBILITY

A. The Contractor shall be responsible for:

1. equipment installation;
2. process and electrical connections; and
3. pre-startup checkout, in accordance with Specifications and as shown on the Drawings.

B. The Owner shall be responsible for:

1. instrument and control device procurement;
2. instrument calibration;
3. control panel procurement;
4. system validation;

5. system operational testing;
6. training; and
7. record drawings and documentation.

1.03 RELATED SECTIONS

- A. Section 13420 - Miscellaneous Instrumentation and Control Devices.
- B. Section 13422 - Pressure Transmitter.
- C. Section 13427 - Level Transmitter-Continuous Level Sensor Element.
- D. Section 13428 - Single Point Level Switch.
- E. Section 13429 - Continuous Level Sensor, Ultrasonic.
- F. Section 13437 - Flow Meter-Magnetic.
- G. Section 13439 - Great Lakes Instruments pH Transmitter.
- H. Section 13442 - Multi-Point Level Switch.
- I. Section 13450 - Control Panels.

1.04 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1-101 - General Standards for Industrial Control and Systems.

1.05 RECORD DRAWINGS AND DOCUMENTATION

A. Record Drawings:

1. Reproducible drawings showing the work as actually constructed and labeled as "Record". Drawings to include:
 - a. Process and Instrumentation Diagram.
 - b. Complete instrumentation and control equipment descriptions.
 - c. Equipment locations.
 - d. Equipment installation details showing dimensions, physical configurations, mounting, process connections, and electrical connections.
 - e. Loop Diagrams.

- f. Electrical schematics.
- g. Panel fabrication details.
- h. Graphic display details.
- i. Bill of materials.

B. Operation and Maintenance Manual:

1. Contents:

The following information, as applicable, for each instrument, equipment, subsystem, and/or control loop:

- a. General introduction and overall description, purpose, functions, simplified theory of operations, etc.
- b. Specifications.
- c. Installation instructions, procedures, sequence, tolerances, and precautions.
- d. Operational procedure.
- e. Shut-down procedures.
- f. Maintenance, calibration, and trouble shooting instructions.
- g. Schematics and wiring diagrams.
- h. Detailed circuit operational description.
- i. Parts lists and spare parts recommendations.
- j. Instrument calibration report.

2. Format:

- a. Drawings and pictorials to illustrate the text to the extent necessary to insure a clear, concise presentation.
- b. Where manufacturer manuals written to cover a family of similar instruments or equipment are included, inapplicable information may be struck out in a neat fashion or the applicable portion may be emphasized by heavily weighted arrows, circles, or boxes.

3. Binding:

- a. Standard 3-inch three ring binder(s).

C. System Validation Documentation:

- 1. Installation and Operational Qualification signed worksheets.

PART 2 REQUIREMENTS

2.01 SCOPE OF WORK

- A. Contractor shall perform the following as shown on the drawings and as specified herein:

1. Install all instruments.
2. Provide and install instrumentation tubing, pipe, gaskets, bolting, fittings, wiring and conduits.
3. Install the control panels.
4. Install all field wiring terminations within the control panels.
5. Install cabling and termination devices for the PLC Area Network.
6. Verify correctness and integrity of all connections and terminations.

B. Owner shall:

1. Provide all instruments.
2. Provide pre-fabricated control panels.
3. Provide cabling and termination devices for the PLC Area Network.
4. Perform instrument calibration, system validation, operational testing, and training.

2.02 INSTRUMENT AND CONTROL DEVICE INSTALLATION

A. Mounting:

1. Mount instruments and control devices as indicated on the Drawings and in accordance with Supplier's recommendations. Supplier's recommendations shall govern in the event of a conflict.
2. Unless specified otherwise, mount instruments:
 - a. Below their process connection point for pressure instruments;
 - b. Level and plumb;
 - c. Rigidly supported;
 - d. Protected from excessive heat, cold, shock and vibration;
 - e. Free of interference with piping, conduit, or other equipment;
 - f. Near as possible to primary connections consistent with instrument accessibility.
3. Mount non-inline devices, instruments with calibration adjustments, or equipment requiring periodic adjustments so that the centerline is not more than 5-feet 0-inches or less than 3-feet 0-inches above grade, walkways, catwalks, or platforms.

B. Process Connections:

1. Provide instrument piping, tubing, block valves, fittings, and other process connections to meet the intended process service and ambient environmental condition for corrosion resistance as shown on the Drawings. Slope lines, as required according to service, to promote self-draining or venting back to the process.
2. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of element without requiring shut down of the process.
3. Include drip legs and blow-down valves for terminations of sense lines at instruments when mounted such that condensation can accumulate.

C. Pneumatic Connections:

1. Terminate pneumatic process tubing as shown on the Drawings.
2. Tubing shall be instrument grade polyethelene for general industrial and chemical applications.
3. Individual tubes shall be neatly bundled and the bundles secured within metal channel or tray with self-locking polyethylene plastic ties.
4. Individual tubes shall be labeled with machine printed tie on plastic tags.
5. Drop lines to air line conditioning devices shall be attached to the top of main headers to reduce the amount of moisture that might run down to the devices.
6. All pneumatic tubing shall be free of sharp bends and kinks. Necessary turns shall have as large a radius as possible. Where it is necessary to clamp tubing, ensure that tubing is not crushed.
7. Conditioning devices shall be installed as close as possible to the point of use, consistent with accessibility for inspection and servicing.

D. Electrical Connections:

1. Unless furnished by the Owner as described above, provide wire, cables, conduits, fittings, and other electrical accessories in accordance with the Drawings and the National Electrical Code.
2. Where wires are terminated on screw terminals, insulated crimped locking

fork lugs shall be used. Lugs shall be of the appropriate size for the terminal block screws.

3. Label individual wires and cables with the identification shown on the Drawings. Wire labels shall be the nonmetallic adhesive label or sleeve type with machine printed identification.
4. Neatly bundle individual wires and cables entering panels and enclosures and secure the bundles with self-locking plastic ties.

E. Equipment Identification:

1. Provide identification tag for instruments not identified by the Supplier as shown on the Drawings. The tag shall be made of stainless steel with 3/16-inch high letters and attached with a stainless steel band with a worm screw clamping device or another method approved by the Owner. Tags shall be plainly visible to a standing observer.

F. Repair of Damaged Finishes:

1. Restore any damaged finish on all instrumentation equipment to the new condition.

G. Protection of Installed Instruments:

1. All field instruments installed shall be protected by covering with plastic sheeting until the instrument is ready to be put in operation at which time the Contractor shall remove all covers.

2.03 CONTROL PANELS

A. Mounting:

1. Mount control panels at locations shown on the Drawings. Ensure that panels are installed level and plumb. Verify that door of each panel may be fully opened without interference.

B. Electrical Connections:

1. Terminate power wires and signal cables on panel terminal blocks and label individual wires and cables with the identification shown on the Drawings. Wire labels shall be the nonmetallic adhesive label or sleeve type with machine printed identification.
2. Provide a separate ground wire from the power distribution panel to the

panel ground point.

3. Neatly bundle individual wires and cables entering the enclosure and secure the bundles with self-locking plastic ties. Signal wiring shall be separated at least 6-inches from any power wiring.

C. Repair of Damaged Finish:

1. Restore any areas of damaged finish on the panels to new condition.

D. Protection of Installed Panel:

1. Each control panel shall be protected by covering with plastic sheeting until the panel is ready to be put in operation at which time the Contractor shall remove all covers.

2.04 PROGRAMMABLE LOGIC CONTROLLER AREA NETWORK
INSTALLATION

- A. Provide conduits, fittings, and other electrical accessories, except cable and cable connector devices which shall be furnished by the Owner, required to install the Modbus Plus Programmable Logic Controller Area Network as shown on the Drawings. Install network cable in either a separate conduit, or if installed on cable tray in an area at least 6-inches away from power conductors, to minimize electrical interference. Install cable connector devices per installation detail drawings.

PART 3 EXECUTION

3.01 INSPECTION

- A. Owner shall inspect, prior to installation, each instrument and piece of equipment for damage, defects, and completeness.
- B. Contractor shall inspect any previously installed related Work and verify that it is ready for installation of instruments and equipment.

3.02 PREPARATION

- A. Contractor shall ensure that installation areas are clean and that dirt and dust generating operations are completed prior to installing instruments and equipment.

3.03 FIELD QUALITY CONTROL

A. System Validation

1. The Owner shall validate that system equipment is operational and performing its intended function within published equipment and system design specifications. The System Validation shall consist of two parts: Installation Qualification (IQ) and Operational Qualification (OQ).

B. Installation Qualification (IQ)

1. Installation Qualification shall include the verification of instrument calibration, commissioning of system equipment, evidence that the system conforms to design specifications and safety requirements, and development of preventive maintenance schedules.
2. The Owner shall be responsible for developing a separate written IQ Protocol for the system. Execution of the Protocol shall be the responsibility of the Owner. Forms specially prepared and part of the IQ Protocol shall be used to document and sign-off each step of the Protocol.

C. Operational Qualification (OQ)

1. Operational Qualification shall demonstrate that the system functions as designed with respect to process control and interlocks under a range of operating conditions. OQ shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify alarms, failure interlocks, and operational interlocks between systems and mechanical equipment, and criteria for system start-up.
2. Defects and malfunctions identified during OQ shall be immediately corrected with approved methods and materials and the OQ test repeated.
3. The Owner shall be responsible for developing a separate written OQ Protocol for the system. Execution of the Protocol shall be the responsibility of the Owner. Forms specially prepared and part of the OQ Protocol shall be used to document and sign-off each step of the Protocol.

3.04 OPERATIONAL TESTING AND FINAL ACCEPTANCE

- A. Upon completion of system validation, operational testing of the system under nominal process conditions shall commence for a period of at least 90 days. During this period, defects and malfunctions identified shall be immediately corrected with approved methods and materials. Upon completion of final operational testing, a certified report shall be prepared by the Owner with

substantiating data sheets, that the total control system meets the functional specifications. This shall constitute final acceptance.

3.05 TRAINING

- A. The Owner shall prepare and execute a training program for operating and maintenance personnel. Vendor resources shall be used, where available, to assist in developing and implementing the training program.

END OF SECTION

SECTION 13415
FUNCTIONAL SPECIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. This Section describes the Instrumentation Control and Monitoring Systems (ICMS) for the Final Stabilization Action at the Ciba-Geigy Facility, Cranston, Rhode Island. The intent of this Section is to supplement, where applicable, other Sections of Division 13, and amplify information contained in other sections.

1.02 FUNCTIONS

- A. The primary function of the ICMS shall be to provide centralized control and monitoring of each unit process for the treatment of extracted ground water. Each ICMS will communicate to the Building 15 Control Room to provide visual and audible information on operating parameters, equipment status, and alarm conditions.
- B. Major constituents of the ICMS include an Analog Subsystem (AS), a Programmable Controller Subsystem (PCS), and Supervisory Computer and Data Acquisition system (SCADA).

1.03 CONTROL PHILOSOPHY

- A. For control purposes, the ICMS shall be divided into the following four (4) Unit Processes:
 - 1. Pumping Wells for Ground Water Extraction
 - 2. Equalization
 - 3. Granulated Activated Carbon Treatment (GAC)
 - 4. Final pH adjustment and Discharge
- B. The ICMS shall be designed to run automatically with minimal operator interface. However, the capability shall be provided for limited local manual control of system operations. Critical functions and changes to the system configuration shall be permitted only after verification of security passwords.

1.04 FUNCTIONAL REQUIREMENTS

A. General:

- 1. The ICMS shall provide all of the functions described herein for each Unit Process. Major equipment items are specified for each Unit Process, however all items of equipment necessary to implement the required Unit Process performance shall be provided.

B. Format:

- 1. Functional requirements are grouped by Unit Process.
- 2. Each Unit Process is divided into four subheadings: Overview, Analog/Digital Subsystem Functions, Programmable Controller

Subsystem Functions, Supervisory Control and Data Acquisition System Functions.

3. The Analog/Digital Subsystem Functions subheading is further divided into two sections: Sensors/Transmitters and Control.
4. The Programmable Controller Subsystem Functions subheading is further divided into four sections: Control, Data Acquisition, Interlocks, and Alarms

C. Components:

1. Analog Subsystem:

- a. Overview - Process Sensor/Transmitter Instruments: Process sensor/transmitter instruments shall measure pressure, pH, level and flow for Unit Processes 1 to 4 as specified herein. The instruments shall have the capability of communicating using the Highway Addressable Remote Transmitter (HART) protocol for the purpose of transmitting process information and instrument status as well as providing a means for remote calibration. If HART compatible devices are not available, the specified instrument shall transmit a 4-20mA dc signal in linear proportion to the measured variable. The devices shall conform to the individual instrument specifications described in subsequent sections of Division 13.

2. Programmable Controller Subsystem:

- a. Overview - Programmable Logic Controller (PLC): The Programmable Logic Controller shall provide all functions for Unit Processes 1 to 4 as specified herein and as shown on the Drawings including:
 - (1) Execution of the appropriate PID loop control algorithm;
 - (2) Data acquisition from process sensors and conversion to engineering units;
 - (3) Totalization of elapsed run time for all equipment items that have an ON/OFF status;
 - (4) Alternation of the lead pumps in the appropriate tanks at a preselected interval;
 - (5) Primary alarm detection and logging; and
 - (6) Interfacing with and supporting the Supervisory Control and Data Acquisition System.

- b. Overview - Operator Interface (OI)
The Operator Interface shall provide local

3. Supervisory Control and Data Acquisition System:

- a. Overview: The Supervisory Control and Data Acquisition System (SCADA) shall consist of a Digital Equipment Corporation minicomputer running the Wonderware InTouch process monitoring and control software package under the Microsoft Disk Operating System (MS-DOS) and Windows Graphical User

Interface program. The computer shall communicate to the PLC over a Modbus Plus link using a communications adapter board and software supplied by the PLC manufacturer. The InTouch software package shall provide a driver to read and write data to the PLC over the Modbus Plus link. The software package shall also act as the primary method of operator interface with the PLC through the means of keyboard, function keys and graphic displays (Man-Machine Interface (MMI)). The MMI shall perform the following specific tasks:

- (1) Display at operator's request operational status of Unit Processes, Unit Process data, alarm indication, and alarm logging;
- (2) Provide operator access, using a minimum of keystrokes, to modify parameter values, change the status of ON/OFF equipment when required, and to acknowledge alarms;
- (3) Provide password protection to prevent entering of unauthorized changes;
- (4) Display real-time trends of all analog/digital process data over an eight hour interval;

The SCADA functions shall perform the following specific tasks:

- (1) Update the internal process database continually by scanning PLC input and output registers;
- (2) Display information from the process database automatically on user created color graphic displays;
- (3) Produce alarm messages based on specific conditions that occur in the process data base;
- (4) Produce historical trend graphs on user selected data samples from the process data base; and
- (5) Generate a user customized report, either on demand or automatically, and direct the report to the video screen, the system printer, to a disk storage file, or other suitable output device.

D. Unit Process 1 - Pumping Wells for Ground Water Extraction (P&ID I1)

1. Overview

- a. The Pumping Wells for Ground Water Extraction shall deliver extracted ground water into Equalization Tank T-300 via a 4" forced main header at an expected combined average flow rate of 60 gallons per minute (gpm) to a maximum of 90 gpm. Flow control from the individual Pumping Wells (PW) shall be accomplished by varying the speed of the pump using a variable frequency drive (VFD) controller to maintain a differential setpoint level between the Monitoring Wells (MW) and Stream Wells (SW).

- b. The Pumping Wells for Ground Water Extraction Unit Process shall consist of three pumping wells (PW-110, PW-120 and PW-130), three monitoring wells (MW-110, MW-120 and MW-130), three stream wells (SW-110, SW-120 and SW-130), three submersible well pumps (P-110, P-120 and P-130), nine continuous level transmitters (LT-110A, LT-110B, LT-110C, LT-120A, LT-120B, LT-120C, LT-130A, LT-130B and LT-130C) three level switches (LS-110, LS-120 and LS-130), three flow transmitters (FT-110, FT-120 and FT-130), three pressure transmitters (PT-110, PT-120 and PT-130), and three pressure indicators (PI-110, PI-120 and PI-130).
- c. Water from Pumping Well PW-110 shall be delivered at a rate sufficient to maintain a differential setpoint level between Stream Well SW-110 and Monitoring Well MW-110 of 1.7 feet as monitored by continuous level probes LT-110C and LT-110B, respectively.
- d. Water from Pumping Well PW-120 shall be delivered at a rate sufficient to maintain a differential setpoint level between Stream Well SW-120 and Monitoring Well MW-120 of 0.5 feet as monitored by continuous level probes LT-120C and LT-120B, respectively.
- e. Water from Pumping Well PW-130 shall be delivered at a rate sufficient to maintain a differential setpoint level between Stream Well SW-130 and Monitoring Well MW-130 of 0.5 feet as monitored by continuous level probes LT-130C and LT-130B, respectively.

2. Analog/Digital Subsystems Functions:

- a. Sensors/Transmitters:
Measure the following parameters and transmit a digital signal to the local PCS (where XXX refers to the equipment/instrument at the appropriate well location):
 - (1) Level of Pumping Well (LT-XXXA).
 - (2) Level of Monitoring Well (LT-XXXB).
 - (3) Level of Stream Well (LT-XXXC).
 - (4) Flow rate of extracted groundwater from Pumping Well (FT-XXX).
 - (5) Pumping Well discharge pressure (PT-XXX).
 - (6) Input status of Pumping Well Level Transmitter (LT-XXXA).
 - (7) Input status of Monitoring Well Level Transmitter (LT-XXXB).
 - (8) Input status of Stream Well Level Transmitter (LT-XXXC).
 - (9) Input status of Flow Transmitter (FT-XXX).
 - (10) Input status of Pressure Transmitter (PT-XXX).

b. Control:

- (1) Input HAND and AUTO selection for each pump motor (HS-XXXB).
- (2) Input ON selection for each pump motor (HS-XXXC).
- (3) Input OFF selection for each pump motor (HS-XXXD).
- (4) Input FIELD DISCONNECT status for each pump motor (HS-XXXA).
- (5) Input status of shelter security switch (YS-XXX).

3. Programmable Controller Subsystem Functions:

a. Control:

- (1) If AUTO selected, provide ON-OFF function to Pump motor P-XXX.
- (2) Provide feedback control of Well Pump P-XXX flow by transmitting a digital signal to VFD-XXX based on differential level of LT-XXXC and LT-XXXB. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, pump motor speed shall be adjusted until the differential level, as determined by measuring Stream Well level at LT-XXXC and Monitoring Well level at LT-XXXB, equals the setpoint. In MANUAL, pump motor speed shall be adjusted by manually varying the loop output digital signal.
- (3) Totalize runtime in minutes for pump P-XXX
- (4) Provide means to reset each runtime totalizer if reset function selected.
- (5) Provide failure indication output if pump P-XXX stops running when it is supposed to be in run state.
- (6) Provide indication output if LT-XXXA status changes.
- (7) Provide indication output if LT-XXXB status changes.
- (8) Provide indication output if LT-XXXC status changes.
- (9) Provide indication output if FT-XXX status changes.
- (10) Provide indication output if PT-XXX status changes.

b. Data Acquisition:

Monitor the following parameters:

- (1) HAND and AUTO selection indication for Pump P-XXX (HS-XXXB)
- (2) Variable Frequency Drive status for Pump P-XXX (VFD-XXX).
- (3) Local FIELD DISCONNECT status for Pump P-XXX (HS-XXXA).
- (4) ON selection indication for Pump P-XXX (HS-XXXC).
- (5) OFF selection indication for Pump P-XXX (HS-XXXD).
- (6) Shelter security switch status for Pumping Well Enclosure XXX (YS-XXX).
- (7) Status of LT-XXXA.
- (8) Status of LT-XXXB.
- (9) Status of LT-XXXC.
- (10) Status of FT-XXX.
- (11) Status of PT-XXX.

Scale to engineering units and store in memory:

- (12) Pumping Well Level, LT-XXXXA.
- (13) Monitoring Well Level, LT-XXXB.
- (14) Stream Well Level, LT-XXXC.
- (15) Pumping Well Flow Rate, FT-XXX
- (16) Pumping Well Discharge Pressure, PT-XXX

c. Interlocks:

- (1) Stop Pumping Well pumps (P-110, P-120 or P-130) if:
Equalization Tank Level (LT-300) high high.

d. Alarms:

- (1) Pumping Well Level (LT-XXXXA) high high.
- (2) Pumping Well Level (LT-XXXXA) high.
- (3) Pumping Well Level (LT-XXXXA) low.
- (4) Pumping Well Level (LT-XXXXA) low low.
- (5) Monitoring Well Level (LT-XXXB) high high.
- (6) Monitoring Well Level (LT-XXXB) high
- (7) Monitoring Well Level (LT-XXXB) low.
- (8) Monitoring Well Level (LT-XXXB) low low.
- (9) Stream Well Level (LT-XXXC) high high.
- (10) Stream Well Level (LT-XXXC) high.
- (11) Stream Well Level (LT-XXXC) low.
- (12) Stream Well Level (LT-XXXC) low low.
- (13) Differential Level high high.
- (14) Differential Level high.
- (15) Differential Level low.
- (16) Differential Level low low.
- (17) Pumping Well Flow (FT-XXX) high high.
- (18) Pumping Well Flow (FT-XXX) high.
- (19) Pumping Well Flow (FT-XXX) low.
- (20) Pumping Well Flow (FT-XXX) low low.
- (21) Pumping Well Discharge Pressure (PT-XXX) high high.
- (22) Pumping Well Discharge Pressure (PT-XXX) high.
- (23) Pumping Well Discharge Pressure (PT-XXX) low.
- (24) Pumping Well Discharge Pressure (PT-XXX) low low.
- (25) Pumping Well Level Transmitter (LT-XXXXA) status change .
- (26) Monitoring Well Level Transmitter (LT-XXXB) status change.
- (27) Stream Well Level Transmitter (LT-XXXC) status change .
- (28) Pumping Well Discharge Pressure Transmitter (PT-XXX) status change.
- (29) Pumping Well Flow Transmitter (FT-XXX) status change.
- (30) Pump P-XXX motor starter tripped.

4. Supervisory Control and Data Acquisition System Functions:

The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:

- (1) Process control loop parameters and mode.
- (2) Mode and status of pump P-XXX
- (3) Analog values of parameters listed in paragraph 3b items 12 to 16.
- (4) Display cumulative run times of Pump P-XXX.
- (5) Display alarm indications as listed in paragraph 3d. Provide means for alarm acknowledgement.
- (6) Provide operator interface to:
 Activate ON-OFF function to pump P-XXX;
 Change differential flow control loop parameters and mode;
 Reset run time totalizer of pump.
- (7) Provide real time trends of analog parameters listed in paragraph 3b items 12 to 16.
- (8) Provide real time trend of differential level control loop output.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the WONDERWARE graphical process interface software.

E. Unit Process 2 - Equalization (P&ID I2)

1. Overview

- a. The Equalization Unit Process consists of one tank to receive the extracted ground water from Unit Process 1 and the ground water obtained from the Soil Vapor Extraction (SVE) Unit Process (See ABCDEFG for description of SVE system) after phase separation. The flow of ground water from the Equalization Unit Process tanks is delivered at a rate sufficient to maintain at a setpoint level in the tank.
- b. The Equalization Unit Process shall consist of the extracted ground water tank (T-200), one mixers (A-200), two pumps (P-210 and P-211), one level transmitters (LT-200), one level switches (LS-200), three pressure indicators (PI-210A, PI-210B and PI-211), one pressure transmitters (PIT-210), one flow indicating transmitters (FIT-200), and twelve hand switches (HS-200A, HS-200B, HS-200C, HS-200D, HS-210A, HS-210B, HS-210C, HS-210D, HS-211A, HS-211B, HS-211C, HS-211D).
- c. The level of tank T-200 shall be maintained at setpoint conditions by monitoring the level continuously at LT-300 and adjusting the flow rate accordingly to a maximum of 90 gpm.

2. Analog Subsystems Functions:

- a. Sensors/Transmitters:
 Measure the following parameters and transmit a digital signal to the local PCS:

- (1) Level of Tank T-200 (LT-200).
- (2) Speed of either pump motor P-210 or P-211 (SIC-210 or SIC-211)
- (3) Discharge Pressure of either Pump P-210 or P-211 (PT-210).
- (4) Effluent flow rate of Tank T-200 (FIT-200).
- (5) Input status of T-200 level transmitter (LT-200).
- (6) Input status of pump P-210 or P-211 discharge pressure transmitter (PT-210).
- (7) Input status of T-200 flow indicating transmitter (FIT-200).

b. Control:

- (1) Input HAND and AUTO selection for agitator motor A-200 (HS-200B).
- (2) Input ON selection for agitator motor A-200 (HS-200C).
- (3) Input OFF selection for agitator motor A-200 (HS-200D).
- (4) Input FIELD DISCONNECT status for agitator motor A-200 (HS-200A).
- (5) Input status of agitator motor A-200 starter auxiliary (YY-200) at Motor Control Center (MCC) PCS.
- (6) Input HAND and AUTO selection for pump motor P-210 (HS-210B).
- (7) Input ON selection for pump motor P-210 (HS-210C).
- (8) Input OFF selection for pump motor P-210 (HS-210D).
- (9) Input FIELD DISCONNECT status for pump motor P-210 (HS-210A).
- (10) Input status of pump motor P-210 variable frequency drive (SIC-210)
- (11) Input HAND and AUTO selection for pump motor P-211 (HS-211B).
- (12) Input ON selection for pump motor P-211 (HS-211C).
- (13) Input OFF selection for pump motor P-211 (HS-211D).
- (14) Input FIELD DISCONNECT status for pump motor P-211 (HS-211A).
- (15) Input status of pump motor P-211 variable frequency drive (SIC-211)

3. Programmable Controller Subsystem Functions:

a. Control:

- (1) If AUTO selected, provide ON-OFF function to agitator motor A-200.
- (2) Totalize runtime in minutes for agitator A-200.
- (3) Provide means to reset each runtime totalizer if reset function selected.
- (4) Provide failure indication output if agitator A-200 stops running when it is supposed to be in run state.
- (5) If AUTO selected, provide ON-OFF function to pump motor P-210.
- (6) Totalize runtime in minutes for pump P-210.

- (7) Provide means to reset each runtime totalizer if reset function selected.
- (8) Provide failure indication output if pump P-210 stops running when it is supposed to be in run state.
- (9) If AUTO selected, provide ON-OFF function to pump motor P-211.
- (10) Totalize runtime in minutes for pump P-211.
- (11) Provide means to reset each runtime totalizer if reset function selected.
- (12) Provide failure indication output if pump P-211 stops running when it is supposed to be in run state.
- (13) Provide feedback control of Equalization Tank T-200 level by transmitting a digital signal to SIC-200. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, level shall be maintained modulating SIC-200 until the level measured at LT-200 equals the setpoint. In MANUAL, SIC-200 may be manually modulated by varying the output digital signal until the desired level is achieved.

b. Data Acquisition:

Monitor the following parameters:

- (1) HAND and AUTO selection indication for agitator A-200 pumps P-210 and P-211 (HS-XXXB).
- (2) ON selection for agitator A-200 pumps P-210 and P-211 (HS-XXXC).
- (3) OFF selection for agitator A-200 pumps P-210 and P-211 (HS-XXXD).
- (4) FIELD DISCONNECT status for agitator A-200 pumps P-210 and P-211 (HS-XXXA).
- (5) Motor starter status for agitator A-200 (YY-200) at MCC PCS.
- (6) Status of LT-200.
- (7) Status of PIT-210.
- (8) Status of FIT-200.

Scale to engineering units and store in memory:

- (9) Equalization tank T-200 Level, LT-200.
- (10) Pump P-210 or P-211 Discharge Pressure, PIT-210.
- (11) Equalization tank T-200 Flow Rate, FIT-200.

c. Interlocks:

- (1) Stop Equalization Tank T-200 discharge pump (P-210 or P-211) if: Tank Level (LT-200) low.
- (2) Stop Equalization Tank T-200 discharge pump (P-210 or P-211) if: Final pH Adjustment Tank (T-500) Level (LT-500) high high.
- (3) Stop Equalization Tank T-200 discharge pump (P-210 or P-211) if: flow rate (FIT-200) greater than 90 gpm.

d. Alarms:

- (1) Equalization Tank T-200 Level (LT-200) high high.
- (2) Equalization Tank T-200 Level (LT-200) high.
- (3) Equalization Tank T-200 Level (LT-200) low.
- (4) Equalization Tank T-200 Level (LT-200) low low.
- (5) Equalization Tank T-200 Pump P-210 or P-211 Discharge Pressure (PIT-210) high high.
- (6) Equalization Tank T-200 Pump P-210 or P-211 Discharge Pressure (PIT-210) high.
- (7) Equalization Tank T-200 Pump P-210 or P-211 Discharge Pressure (PIT-210) low.
- (8) Equalization Tank T-200 Pump P-210 or P-211 Discharge Pressure (PIT-210) low low.
- (9) Equalization Tank T-200 Flow (FIT-200) high high.
- (10) Equalization Tank T-200 Flow (FIT-200) high.
- (11) Equalization Tank T-200 Flow (FIT-200) low.
- (12) Equalization Tank T-200 Flow (FIT-200) low low.
- (13) Equalization Tank T-200 Level Transmitter (LT-200) status change.
- (14) Equalization Tank T-200 Flow Indicating Transmitter (FIT-200) status change.
- (15) Agitator A-200 motor starter (YY-200) tripped.

4. Supervisory Control and Data Acquisition System Functions:
The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:

- (1) Process control loop parameters and mode.
- (2) Mode and status of agitator A-200 pumps P-210 and P-211
- (3) Digital values of parameters listed in paragraph 3b items 9 to 11.
- (4) Display cumulative run times of Equalization Tank agitator A-200 pumps P-210 and P-211.
- (5) Display alarm indications as listed in paragraph 3d. Provide means for alarm acknowledgement.
- (6) Provide operator interface to:
Activate ON-OFF function to agitator A-200 pumps P-210 and P-211;
Change Equalization Tank T-200 level control loop parameters and mode;
Reset run time totalizer of each agitator and pump;
Change alarm setpoint value for digital parameters listed in paragraph 3b items 9 to 11;
- (7) Provide real time trends of digital parameters listed in paragraph 3b items 9 to 11.
- (8) Provide real time trend of level control loop output for Equalization Tank T-200.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the Wonderware graphical process interface software.

F. Unit Process 3 - Granulated Activated Carbon (GAC) System
(P&IDs E-51303 and E-51307)

1. Overview

- a. The GAC system consists of three units with carbon capacity of 20,000 pounds each. The GAC units are 10 feet in diameter by 18 feet total height and are capable of operating at pressures of 125 psig. Groundwater is pumped to the GAC system through a 4" carbon steel pipe. Flows to the individual GAC units will be based on the number of units in operation and shall be maintained by a pneumatically actuated flow valve. Flow to the GAC unit may be diverted directly to the Final pH Adjustment Tank by means of a flow valve. The effluent from the GAC system flows through a 4" carbon steel pipe to the Final pH Adjustment Tank.
- b. The GAC System Unit Process shall consist of three Modified Model 10 Granulated Activated Carbon Units (F-401, F-402 and F-403), twenty flow valves (FV-400A, FV-400B, FV-401A, FV-401B, FV-401C, FV-401D, FV-401E, FV-401F, FV-402A, FV-402B, FV-402C, FV-402D, FV-402E, FV-402F, FV-403A, FV-403B, FV-403C, FV-403D, FV-403E and FV-403F), forty valve position indicators (ZSH-400A, ZSL-400A, ZSH-400B, ZSL-400B, ZSH-401A, ZSL-401A, ZSH-401B, ZSL-401B, ZSH-401C, ZSL-401C, ZSH-401D, ZSL-401D, ZSH-401E, ZSL-401E, ZSH-401F, ZSL-401F, ZSH-402A, ZSL-402A, ZSH-402B, ZSL-402B, ZSH-402C, ZSL-402C, ZSH-402D, ZSL-402D, ZSH-402E, ZSL-402E, ZSH-402F, ZSL-402F, ZSH-403A, ZSL-403A, ZSH-403B, ZSL-403B, ZSH-403C, ZSL-403C, ZSH-403D, ZSL-403D, ZSH-403E, ZSL-403E, ZSH-403F and ZSL-403F), three pressure differential switches (PDS-401, PDS-402, and PDS-403) and six pressure indicating transmitters (PIT-401A, PIT-401B, PIT-402A, PIT-402B, PIT-403A, and PIT-403B).
- c. Groundwater flow through GAC unit F-XXX (where XXX identifies the individual GAC unit) shall be achieved by opening flow valves FV-XXXA and FV-XXXB.
- d. At scheduled intervals, or when PDS-XXXX is activated, the GAC units shall be backwashed at a flow of 560 gpm. Backwash shall be automatically controlled after initiation by operating personnel. The backwash cycle shall close FV-XXXA and FV-XXXB and opening FV-XXXC and FV-XXXD of the GAC unit to be backwashed.

2. Analog Subsystems Functions:

- a. Sensors/Transmitters:
Measure the following parameters and transmit a digital signal to the local PCS:

- (1) Inlet pressure of GAC F-401 (PIT-401A).
- (2) Outlet pressure of GAC F-401 (PIT-401B).
- (3) Inlet pressure of GAC F-402 (PIT-402A).
- (4) Outlet pressure of GAC F-402 (PIT-402B).
- (5) Inlet pressure of GAC F-403 (PIT-403A).
- (6) Outlet pressure of GAC F-403 (PIT-403B).

b. Control:

- (1) Position of GAC system influent flow valve (FV-400A).
- (2) Position of GAC system by-pass flow valve (FV-400B).
- (3) Input status of GAC F-401 inlet pressure indicating transmitter (PIT-401A).
- (4) Position of GAC F-401 inlet flow valve (FV-401A).
- (5) Position of GAC F-401 effluent flow valve (FV-401B).
- (6) Position of GAC F-401 backwash inlet flow valve (FV-401C).
- (7) Position of GAC F-401 backwash effluent flow valve (FV-401D).
- (8) Position of GAC F-401 series configuration flow valve (FV-401E).
- (9) Position of GAC F-401 carbon inlet flow valve (FV-401F).
- (10) Position of GAC F-402 inlet flow valve (FV-402A).
- (11) Position of GAC F-402 effluent flow valve (FV-402B).
- (12) Position of GAC F-402 backwash inlet flow valve (FV-402C).
- (13) Position of GAC F-402 backwash effluent flow valve (FV-402D).
- (14) Position of GAC F-402 series configuration flow valve (FV-402E).
- (15) Position of GAC F-402 carbon inlet flow valve (FV-402F).
- (16) Position of GAC F-403 inlet flow valve (FV-403A).
- (17) Position of GAC F-403 effluent flow valve (FV-403B).
- (18) Position of GAC F-403 backwash inlet flow valve (FV-403C).
- (19) Position of GAC F-403 backwash effluent flow valve (FV-403D).
- (20) Position of GAC F-403 series configuration flow valve (FV-403E).
- (21) Position of GAC F-403 carbon inlet flow valve (FV-403F).
- (22) Input status of GAC F-401 outlet pressure indicating transmitter (PIT-401B).
- (23) Input status of GAC F-402 inlet pressure indicating transmitter (PIT-402A).
- (24) Input status of GAC F-402 outlet pressure indicating transmitter (PIT-402B).
- (25) Input status of GAC F-403 inlet pressure indicating transmitter (PIT-403A).
- (26) Input status of GAC F-403 outlet pressure indicating transmitter (PIT-403B).

3. Programmable Controller Subsystem Functions:

a. Control:

- (1) Totalize runtime in minutes for individual GAC Units.
- (2) Provide means to reset each runtime totalizer if reset function selected.
- (3) Provide control of GAC System valves as follows:
If feed to GAC units is desired, open FV-400A.
If direct feed to Final pH Adjustment Tank is desired, close GAC system flow valve FV-400A and open by-pass flow valve FV-400B.
- (4) Provide output indication if PIT-401 status changes.
- (5) Provide output indication if PIT-402 status changes.
- (6) Provide output indication if PIT-403 status changes.
- (7) Provide output indication if FV-400a or FV-400B status changes.
- (8) Provide output indication if FV-401A, FV-401B, FV-401C, FV-401D, FV-401E or FV-401F status changes.
- (9) Provide output indication if FV-402A, FV-402B, FV-402C, FV-402D, FV-402E or FV-402F status changes.
- (10) Provide output indication if FV-403A, FV-403B, FV-403C, FV-403D, FV-403E or FV-403F status changes.

b. Data Acquisition:

Monitor the following parameters:

- (1) Status of flow valve FV-400A at ZSH-400A and ZSL-400A.
- (2) Status of flow valve FV-400B at ZSH-400B and ZSL-400B.
- (3) Status of flow valve FV-401A at ZSH-401A and ZSL-400A.
- (4) Status of flow valve FV-401B at ZSH-401B and ZSL-400B.
- (5) Status of flow valve FV-401C at ZSH-401C and ZSL-400C.
- (6) Status of flow valve FV-401D at ZSH-401D and ZSL-400D.
- (7) Status of flow valve FV-401E at ZSH-401E and ZSL-400E.
- (8) Status of flow valve FV-401F at ZSH-401F and ZSL-400F.
- (9) Status of flow valve FV-402A at ZSH-402A and ZSL-400A.
- (10) Status of flow valve FV-402B at ZSH-402B and ZSL-400B.
- (11) Status of flow valve FV-402C at ZSH-402C and ZSL-400C.
- (12) Status of flow valve FV-402D at ZSH-402D and ZSL-400D.
- (13) Status of flow valve FV-402E at ZSH-402E and ZSL-400E.
- (14) Status of flow valve FV-402F at ZSH-402F and ZSL-400F.
- (15) Status of flow valve FV-403A at ZSH-403A and ZSL-400A.
- (16) Status of flow valve FV-403B at ZSH-403B and ZSL-400B.
- (17) Status of flow valve FV-403C at ZSH-403C and ZSL-400C.
- (18) Status of flow valve FV-403D at ZSH-403D and ZSL-400D.
- (19) Status of flow valve FV-403E at ZSH-403E and ZSL-400E.
- (20) Status of flow valve FV-403F at ZSH-403F and ZSL-400F.
- (21) Status of pressure differential switch PDS-401.
- (22) Status of pressure differential switch PDS-402.
- (23) Status of pressure differential switch PDS-403.

Scale to engineering units and store in memory:

- (24) GAC Unit F-401 inlet pressure, PIT-401A.
- (25) GAC Unit F-401 outlet pressure, PIT-401B.
- (26) GAC Unit F-402 inlet pressure, PIT-402A.
- (27) GAC Unit F-402 outlet pressure, PIT-402B.
- (28) GAC Unit F-403 inlet pressure, PIT-403A.
- (29) GAC Unit F-403 outlet pressure, PIT-403B.

c. Interlocks:

- (1) When system is in operation FV-400B may be opened if: correct password has been entered.
- (2) When high pressure differential switch PDS-XXX activated: stop Equalization Tank T-200 transfer pump P-XXX.
- (3) When calculated high differential pressure (where calculated differential pressure equals PIT-XXXA minus PIT-XXXB) activated and PDS-XXX not activated: stop Equalization Tank T-200 transfer pump P-XXX.

d. Alarms:

- (1) FV-400A position open (ZSH-400A) or closed (ZSL-400A) fails to activate.
- (2) FV-400B position open (ZSH-400B) or closed (ZSL-400B) fails to activate.
- (3) GAC Unit F-401 inlet pressure (PIT-401A) high high.
- (4) GAC Unit F-401 inlet pressure (PIT-401A) high.
- (5) GAC Unit F-401 inlet pressure (PIT-401A) low.
- (6) GAC Unit F-401 inlet pressure (PIT-401A) low low.
- (7) GAC Unit F-401 output pressure (PIT-401B) high high.
- (8) GAC Unit F-401 output pressure (PIT-401B) high.
- (9) GAC Unit F-401 output pressure (PIT-401B) low.
- (10) GAC Unit F-401 output pressure (PIT-401B) low low.
- (11) FV-401A position open (ZSH-401A) or closed (ZSL-401A) fails to activate.
- (12) FV-401B position open (ZSH-401B) or closed (ZSL-401B) fails to activate.
- (13) FV-401C position open (ZSH-401C) or closed (ZSL-401C) fails to activate.
- (14) FV-401D position open (ZSH-401D) or closed (ZSL-401D) fails to activate.
- (15) FV-401E position open (ZSH-401E) or closed (ZSL-401E) fails to activate.
- (16) FV-401F position open (ZSH-401F) or closed (ZSL-401F) fails to activate.
- (17) GAC Unit F-402 inlet pressure (PIT-402A) high high.
- (18) GAC Unit F-402 inlet pressure (PIT-402A) high.
- (19) GAC Unit F-402 inlet pressure (PIT-402A) low.
- (20) GAC Unit F-402 inlet pressure (PIT-402A) low low.
- (21) GAC Unit F-402 outlet pressure (PIT-402B) high high.
- (22) GAC Unit F-402 outlet pressure (PIT-402B) high.

- (23) GAC Unit F-402 outlet pressure (PIT-402B) low.
- (24) GAC Unit F-402 outlet pressure (PIT-402B) low low.
- (25) FV-402A position open (ZSH-402A) or closed (ZSL-402A) fails to activate.
- (26) FV-402B position open (ZSH-402B) or closed (ZSL-402B) fails to activate.
- (27) FV-402C position open (ZSH-402C) or closed (ZSL-402C) fails to activate.
- (28) FV-402D position open (ZSH-402D) or closed (ZSL-402D) fails to activate.
- (29) FV-402E position open (ZSH-402E) or closed (ZSL-402E) fails to activate.
- (30) FV-402F position open (ZSH-402F) or closed (ZSL-402F) fails to activate.
- (31) GAC Unit F-403 inlet pressure (PIT-403A) high high.
- (32) GAC Unit F-403 inlet pressure (PIT-403A) high.
- (33) GAC Unit F-403 inlet pressure (PIT-403A) low.
- (34) GAC Unit F-403 inlet pressure (PIT-403A) low low.
- (35) GAC Unit F-403 outlet pressure (PIT-403B) high high.
- (36) GAC Unit F-403 outlet pressure (PIT-403B) high.
- (37) GAC Unit F-403 outlet pressure (PIT-403B) low.
- (38) GAC Unit F-403 outlet pressure (PIT-403B) low low.
- (39) FV-403A position open (ZSH-403A) or closed (ZSL-403A) fails to activate.
- (40) FV-403B position open (ZSH-403B) or closed (ZSL-403B) fails to activate.
- (41) FV-403C position open (ZSH-403C) or closed (ZSL-403C) fails to activate.
- (42) FV-403D position open (ZSH-403D) or closed (ZSL-403D) fails to activate.
- (43) FV-403E position open (ZSH-403E) or closed (ZSL-403E) fails to activate.
- (44) FV-403F position open (ZSH-403F) or closed (ZSL-403F) fails to activate.

4. Supervisory Control and Data Acquisition System Functions:
The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:

- (1) Process control loop parameters and mode.
- (2) Analog values of parameters listed in paragraph 3b items 24 to 29.
- (3) Display cumulative run times of individual GAC Units
- (4) Display flow totalizer for individual GAC Units
- (5) Display alarm indications as listed in paragraph 3d.
- (6) Provide means for alarm acknowledgement.
- (7) Provide operator interface to:
 - Select individual GAC Units;
 - Select individual GAC Units for backwash;
 - Reset run time totalizer of individual GAC Units;
- (8) Provide real time trends of analog parameters listed in paragraph 3b items 24 to 29.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the MONITROL graphical process interface software.

G. Unit Process 6 - Final pH Adjustment and Discharge (P&ID I5)

1. Overview

- a. The effluent from the GAC Unit Process will enter the Final pH Adjustment Tank via a 4" carbon steel pipe. Discharge flow will be by gravity as a function of influent flow.
- b. The Final pH Adjustment Unit Process shall consist of the Final pH Adjustment Tank (T-500) one mixer (A-500), two chemical addition pumps (P-520 and P-530), one level transmitter (LT-500), one flow indicating transmitter (FIT-500), and two pH probes and transmitters (AIT-500A and AIT-500B).
- c. The final pH of the effluent shall be maintained within discharge limits by the addition of either a sodium hydroxide solution utilizing P-520 or sulfuric acid solution utilizing pump P-530 based on the pH measured at primary control element AIT-500A. The secondary pH control element, AIT-500B, will be used to confirm the pH value and will serve as a back-up to the primary control element. Discharge flow will be continuously monitored in the vertical leg of the discharge pipe on FIT-500. A continuous level transmitter, LT-500, shall monitor the tank level.

2. Analog Subsystems Functions:

a. Sensors/Transmitters:

Measure the following parameters and transmit digital signal to the local PCS:

- (1) Level of Final pH Adjustment tank (LT-500).
- (2) Final effluent flow (FIT-500).

Measure the following parameters and transmit a linearly proportional signal to the local PCS:

- (2) pH of the Final Effluent as measured at the primary control element (AIT-500A).
- (2) pH of the Final Effluent as measured at the secondary control element (AIT-500B).

b. Control:

- (1) Input HAND and AUTO selection for agitator motor A-500 (HS-400B).
- (2) Input ON selection for agitator motor A-500 (HS-500C).

- (3) Input OFF selection for agitator motor A-500 (HS-500D).
- (4) Input FIELD DISCONNECT status for agitator motor A-500 (HS-500A).
- (5) Input status of agitator motor A-500 starts auxiliary (YY-500) at Motor Control Center (MCC) PCS.
- (6) Input HAND and AUTO selection for pump motor P-520 (HS-520).
- (7) Input status of pump motor P-520 power relay auxiliary (YY-520).
- (8) Input HAND and AUTO selection for pump motor P-530 (HS-530).
- (9) Input status of pump motor P-530 power relay auxiliary (YY-530).
- (10) Input status of Sodium Hydroxide Tote level switch (LS-520).
- (11) Input status of Sulfuric Acid Tote level switch (LS-530).

3. Programmable Controller Subsystem Functions:

a. Control:

- (1) If AUTO selected, provide ON-OFF function to agitator motor A-500.
- (2) Totalize runtime in minutes for agitator A-500.
- (3) Provide means to reset runtime totalizer if reset function selected.
- (4) Provide failure indication output if agitator A-500 stops running when it is supposed to be in the run state.
- (5) If AUTO selected provide ON-OFF function to sodium hydroxide feed pump motor P-520.
- (6) Totalize runtime in minutes for agitator P-520.
- (7) Provide means to reset runtime totalizer if reset function selected.
- (8) Provide failure indication output if agitator P-520 stops running when it is supposed to be in the run state.
- (9) If AUTO selected provide ON-OFF function to sulfuric acid feed pump motor P-530.
- (10) Totalize runtime in minutes for agitator P-530.
- (11) Provide means to reset runtime totalizer if reset function selected.
- (12) Provide failure indication output if agitator P-530 stops running when it is supposed to be in the run state.
- (13) Provide feedback control of Final pH Adjustment Tank T-500 pH by transmitting an analog signal to the local PCS. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, addition of either sodium hydroxide or sulfuric acid shall be delivered by activating either pump P-520 or P-530, respectively, until the pH measured at the primary control element AIT-500 equals the setpoint. In MANUAL, pump P-520 or P-530 may be activated to deliver either sodium hydroxide or sulfuric acid, respectively, until the desired pH is achieved.

b. Data Acquisition:

Monitor the following parameters:

- (1) HAND and AUTO selection indication for agitator A-500 (HS-500B) and pumps P-520 and P-530 (HS-XXX).
- (2) ON selection for agitator A-500 (HS-500C).
- (3) OFF selection for agitator A-500 (HS-500D).
- (4) FIELD DISCONNECT status for agitator A-500 (HS-500A).
- (5) Power relay status for pumps P-520 and P-530 (YY-XXX).

Scale to engineering units and store in memory:

- (6) Final pH Adjustment Tank, LT-500.
- (7) Final effluent flow, FIT-500.

c. Interlocks:

- (1) Stop either P-210 or P-211 if: AIT-500A low low.
- (2) Stop either P-210 or P-211 if: AIT-500A high high.
- (3) Stop either P-210 or P-211 if: AIT-500B low low.
- (4) Stop either P-210 or P-211 if: AIT-500B high high.
- (5) Stop either P-210 or P-211 if: LT-500 high high.

d. Alarms:

- (1) Final effluent pH (AIT-500A) high high.
- (2) Final effluent pH (AIT-500A) high.
- (3) Final effluent pH (AIT-500A) low.
- (4) Final effluent pH (AIT-500A) low low.
- (5) Final effluent pH (AIT-500B) high high.
- (2) Final effluent pH (AIT-500B) high.
- (3) Final effluent pH (AIT-500B) low.
- (4) Final effluent pH (AIT-500B) low low.

4. Supervisory Control and Data Acquisition System Functions:

The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:

- (1) Process control loop parameters and mode.
- (2) Mode and status pumps P-520 and P-530.
- (3) Analog values of parameters listed in paragraph 3b items 6 and 7.
- (4) Display cumulative run times of agitator motor A-500 and pumps P-520 and P-530.
- (5) Display alarm indications as listed in paragraph 3d and provide means for alarm acknowledgement.
- (6) Provide operator interface to:
Activate ON-OFF function to agitator A-500 and pumps P-520 and P-530;
Change Final pH Adjustment Tank control loop parameters and mode;

Reset run time totalizer of agitator A-500 and pumps P-520 and P-530;

- (8) Provide real time trends of analog parameters listed in paragraph 3b items 6 and 7.
- (9) Provide real time trend of pH control loop output.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the MONITROL graphical process interface software.

SECTION 13420

MISCELLANEOUS INSTRUMENTATION AND CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Miscellaneous field mounted instrumentation and control devices not otherwise described in other sections of Division 13400.

1.02 RELATED SECTIONS

- A. Section 13410 - General Instrumentation and Control Requirements.

1.03 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum).
- B. ANSI 16.5-81 Pipe Flanges and Flanged Fittings.

1.04 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per device) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.

5. Warranties for each component.
6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.
7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.05 **WARRANTY**

- A. Provide manufacturer's standard warranty on each component provided.

1.06 **QUALITY ASSURANCE**

A. **Manufacturer:**

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. **Maintainability:**

1. Designed for ease of maintenance and access to critical parts shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.
3. Manufacturer or distributor shall be capable of repair or provide replacement maintenance within 24 hours or less response time.

C. **Materials and Installation:**

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

A. General:

1. Tag No.: See TABLE "A"
2. Service: See TABLE "A"
4. Mounting: Stem-Mounting type
2. Pressure range: See TABLE "A"
3. Process fluid: See TABLE "A"
4. Protective Seal: Provide chemical seal

B. Construction:

1. Pressure Element: Bourdon tube or bellows type with 270 degrees clockwise pointer travel
2. Element Material: Wetted parts to be corrosion-resistant to the process fluid
3. Dial: 4 1/2-inches diameter, white face with black numbers
4. Case Material: Black phenolic
5. Connection Size: Male 1/2-inch NPT with square wrench flats
6. Movement
Material: Manufacturer's Standard
7. Ring Style: Manufacturer's Standard
8. Blow-out
Protection: None
9. Lens: Manufacturer's Standard
10. Nominal Accuracy: ± 0.5 percent of span
11. Gage Liquid Fill: Glycerin and Water

C. Chemical Seal:

1. Material: Wetted parts to be corrosion-resistant to the process fluid
Diaphragm to be welded to the top housing
2. Fill Fluid: Silicone
3. Process
Connection: 3/4-inch NPT female with a flushing connection
4. Gage Connection: 1/2-inch NPT female

D. Acceptable Manufacturers:

1. Gauges:
 - a. Ametek
 - b. Ashcroft
 - c. U.S. Gauge

2. Diaphragm Seals:
 - a. Ametek
 - b. Ashcroft
 - c. Mansfield and Green

2.02 FLOW INDICATOR, VARIABLE AREA

- A. General:
 1. Tag No.: See TABLE "B"
 2. Service: See TABLE "B"
 3. Function: Visual Indication
 4. Mounting: Pipe Mount
 5. Connection Size: See TABLE "B"
 6. Connection Type: ANSI Class 150 Flange
- B. Meter:
 1. Size: To Be Determined
 2. Tube Material: Manufacturer's Standard
 3. Meter Scale Length and Type: Manufacturer's Standard
 4. Meter Scale Range: To Be Determined
 5. Rated Accuracy: Manufacturer's Standard
- C. Fluid Data:
 1. Fluid: See TABLE "B"
 2. Color or Transparency: To Be Determined
 3. Maximum Flow: See TABLE "B"
 4. Normal Flow: See TABLE "B"
 5. Minimum Flow: See TABLE "B"
 6. Operating Specific Gravity: See TABLE "B"
 7. Maximum Operating Viscosity: See TABLE "B"
 8. Operating Pressure: See TABLE "B"
 9. Operating Temperature: 70 degrees Fahrenheit
 10. Maximum Allowable Pressure Drop: To Be Determined

- D. Service Conditions:
 - 1. Ambient Temperature: Plus 32 to 125 degrees Fahrenheit
- E. Construction Materials:
 - 1. Wetted parts shall be corrosion-resistant to the process fluid.
- F. Acceptable Manufacturers:
 - 1. Cole-Parmer

2.03 PRESSURE RELIEF VALVES

- A. General:
 - 1. Tag No.: See TABLE "C"
 - 2. Service: See TABLE "C"
 - 3. Application: Self-Actuated Pressure Relief for Pumping Well
 - 4. Valve Size: See TABLE "C"
 - 5. Port Size: See TABLE "C"
 - 6. Valve Orientation: Vertical
 - 7. Flange Face Finish: Standard ANSI Class 150 raised face flanges per ANSI B16.5
- B. Construction Materials:
 - 1. Body and Bonnet: Manufacturer's Standard
 - 2. Seat and Disc: Manufacturer's Standard
 - 3. Guide and Rings: Manufacturer's Standard
 - 4. Spring: Manufacturer's Standard
 - 5. Bellows: Manufacturer's Standard
- C. Fluid Data:
 - 1. Process Fluid: See TABLE "C"
 - 2. Required Capacity: See TABLE "C"
 - 3. Operating Pressure: See TABLE "C"
 - 4. Set Pressure: Adjustable
- D. Acceptable Manufacturers:
 - 1. Birkett/Richards
 - 2. Crosby Valve & Gage Co.
 - 3. Fulflo
 - 4. Kunkle
 - 5. Teledyne Farris Engineering

2.04 TEMPERATURE TRANSMITTER

A. General:

1. Tag Nos.: TT-1, TT-2, TT-3, TT-4, TT-110, TT-120
2. Service: Control Panel Temperature
3. Function: Convert RTD temperature input in linear proportion, to a 4 to 20 milliamp DC output signal capable of transmission into at least a 600 ohm load at 24 Volts DC. Signal and power transmission provided on a single pair of wires.
4. Housing: Manufacturer's Standard for Wall Mounting
5. Mounting: Wall Mountable
6. Enclosure Class: Non-Hazardous
7. Power Supply: 24 Volts DC
8. Operating Ambient Temperature
Limits: Plus 32 to 122 degrees Fahrenheit
9. Range: Plus 20 to 120 degrees Fahrenheit
10. Output Span: Field adjustable for 4-20 milliamps DC
11. Accuracy: Plus or minus 0.5 percent of calibrated span or better.
12. Stability: 0.01 percent/degree Centigrade zero drift or better
0.01 percent/degree Centigrade span drift or better

B. Sensing Element:

1. Sensing Element: 2-wire platinum RTD capable of measuring temperature from plus 20 to 122 degrees Fahrenheit

C. Acceptable Manufacturers:

1. Action Instruments Type RTD Wall Mount, Part No. #E421-0036

2.05 RELAYS-ELECTROMAGNETIC

A. General Purpose Relays:

1. General purpose industrial type relays shall be used to interface between the programmable logic controller panel and external devices with separate voltage sources. They shall have a coil rated for 120 Volts AC, a Single-Pole-Double-Throw contact rated for 10 amperes at 120 Volts AC and be equipped with a light emitting diode indicator lamp. They shall be enclosed in a transparent plastic dust cover and be mounted on a socket assembly. The socket assembly shall be capable of holding up to four relays and have compression clamp connectors for input and output wire connections. The socket assembly shall also be mountable on DIN type mounting rail.

2. Acceptable Manufacturers:
 - a. Entrelec Type RM 421A, Part No. 020 060.06

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, calibrate, and start up field mounted elements in strict compliance with the manufacturer's requirements and recommendations. Present conflicts between manufacturer's requirements and recommendations and these specifications or Drawings to Owner for resolution before affected work is started.
- B. Connections of instruments to process piping shall include, as close as practical to the point of connection, a tight closing block valve suitable for the maximum process pressure and temperature and for the material involved.
- C. Protect and isolate instruments from vibration, temperature extremes, radiant heat, rain or falling water, and similar adverse conditions unless specifically intended for such service.
- D. Impulse lines of pressure or pressure differential instruments shall be as short as practical and installed with a minimum slope of 1-inch per foot (1:12) downward toward the instrument in liquid system and upward toward the instrument in gaseous systems. If this preferred direction of slope cannot be maintained, submit for approval an installation configuration utilizing traps, drains, and/or vents at high and low points which will ensure freedom from mixed phase offset effects and provide ease of purging or draining.
- E. Mark field mounted elements with data required for calibration such as location of adjustments, span, offset, zero suppression, and test voltages. If such data are not provided in permanent markings or on the manufacturer's nameplate, affix a durable tag or label in a protected location which will become readily visible in the normal course of servicing the instrument.
- F. Before installing, carefully clean valves of all foreign material, and inspect valves in OPEN and CLOSED positions. Install valves in accordance with these Specifications and in accordance with the manufacturer's written instructions.
- G. Insofar as practical, the valve assemblies shall be completely factory assembled and shipped as a unit. The parts and assemblies that are, of necessity, shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final identification and assembly in the field.

3.02 EQUIPMENT TESTING AND CALIBRATION

A. Factory Tests and Calibration:

1. Factory-test field mounted elements by the manufacturer to assure satisfactory performance prior to shipment. Whenever possible, include calibration to actual range and conditions of use. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

B. Field Tests and Calibration:

1. Calibrate field mounted elements, which were not calibrated to final working values of range, span, and zero suppression at the factory, prior to or at the time of installation. This calibration shall meet the same requirements of accuracy and traceability required for factory testing above. The Owner shall be given 48 hours notice and the opportunity to witness this calibration.

END OF SECTION

Attachment A - Table "A", 1 page

Attachment B - Table "B", 1 page

Attachment C - Table "C", 1 page

TABLE "A"
Pressure Gauges

Tag No.	Service	Process Fluid	Gauge Dial Range psig
PI-110	Outlet Pressure Indicator for Well PW-110	Ground Water	0 - 100
PI-120	Outlet Pressure Indicator for Well PW-120	Ground Water	0 - 100
PI-130	Outlet Pressure Indicator for Well PW-130	Ground Water	0 - 100
PI-140	Outlet Pressure Indicator for Well PW-140	Ground Water	0 - 100
PI-200	Inlet Pressure Indicator for pumps P-210 and P-211	Ground Water	0 - 100
PI-210	Pump Outlet Pressure Indicator for Pump P-210	Ground Water	0 - 100
PI-211	Pump Outlet Pressure Indicator for Pump P-211	Ground Water	0 - 100
PI-220	Pump Outlet Pressure Indicator for Pump P-220	Polymer	0 - 60
PI-300	Inlet Pressure Indicator for pumps P-310 and P-311	Ground Water	0 - 100
PI-310	Pump Outlet Pressure Indicator for pump P-310	Ground Water	0 - 100
PI-311	Pump Outlet Pressure Indicator for Pump P-311	Ground Water	0 - 100
PI-520	Pump Outlet Pressure Indicator for Pump P-520	Sodium Hydroxide	0 - 60
PI-530	Pump Outlet Pressure Indicator for Pump P-530	Sulfuric Acid	0 - 60

TABLE "B"

Flow Indicators, Variable Area

Tag No.	Service	Process Fluid	Nominal Flow gph	Connection Size inches, NPT	Operating Specific Gravity	Maximum Operating Viscosity Centistokes	Operating Pressure psig	Color
FI-220	Visual Flow Indicator for Polymer Pump P-220	Polymer	1.5	1/4	To Be De- termined	To Be Determined	75 maximum	White
FI-520	Visual Flow Indicator for Sodium Hydroxide Pump P-520	Sodium Hydroxide 35% Liquid	1.5	1/4	1.27	To Be Determined	11 minimum	Transparent
FI-530	Visual Flow Indicator for Sulfuric Acid Pump P-530	Sulfuric Acid 10% by Weight	1.0	1/4	1.83	14.6	5 minimum	Transparent

TABLE "C"

Pressure Control Valves

Tag No.	Service	Valve Body Type	Valve Size inches	Process Fluid	Required Capacity gpm	Operating Pressure psig	Set Pressure psig
PCV-110	Pressure Relief for Pumping Well PW-110	Flange ANSI 150	2	Ground Water	50	46	49
PCV-120	Pressure Relief for Pumping Well PW-120	Flange ANSI 150	2	Ground Water	15	63	65
PVC-130	Pressure Relief for Pumping Well PW-130	Flange ANSI 150	2	Ground Water	10	73	75
PVC-140	Pressure Relief for Pumping Well PW-140	Flange ANSI 150	2	Ground Water	10	73	75

SECTION 13422

PRESSURE TRANSMITTER - ELECTRONIC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of electronic pressure transmitter and auxiliary equipment options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per transmitter) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.
 - 6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.

7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The pressure transmitter shall consist of a sensor with an integral electronic transmitter and shall be capable of measuring either gage or absolute pressure.

B. Sensor:

1. The pressure sensor design shall use the concept of the capacitance cell. Process pressure shall be transmitted through an isolating diaphragm and fill fluid to a sensing diaphragm in the center of the capacitance cell. Capacitor plates on both sides of the sensing diaphragm shall detect its position. The differential capacitance between the sensing diaphragm and the capacitor plates shall be directly proportional to process pressure.

C. Electronic Transmitter:

1. The electronic transmitter shall convert the process pressure measurement, in linear proportion, to a 4 to 20 milliamps DC output signal capable of transmission into at least a 600 ohm load at 24 Volts DC. Signal and 24 Volts DC power transmission shall be provided on a single pair of wires.
2. Transmitter functions shall be controlled by a microprocessor. Transmitter shall include a non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption.
3. Transmitter shall be capable of superimposing a digital communication signal utilizing the Highway Addressable Remote Transducer (HART) protocol on the 4-20 milliamps DC signal for interrogation, configuration, and diagnostics with a HART host communicator device without interruption of the transmitter's output signal. As a minimum, the transmitter shall be capable of implementing the Universal and Common-Practice Commands as defined in the HART protocol.

1.05 WARRANTY

- ##### A. Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No.: See TABLE "A" (Attachment)
2. Type: Gage Pressure
3. Service: See TABLE "A"
4. Power Supply: 24 Volts DC
5. Ambient Temp. Limits: Minus 20 to plus 185 degrees Farenheit
6. Humidity Limits: 10-100 percent relative humidity

B. Sensor:

1. Wetted Parts
Material: 316 Stainless Steel
2. Element Material
and Type: 316 Stainless Steel Diaphragm
3. Process
Connection: 1/2-inch NPT 316 Stainless Steel
4. Fill Fluid: Silicone
5. Process Fluid: See TABLE "A"
6. Remote Diaphragm
Seal: Yes (See 2.01-D-3 Accessories)

C. Transmitter:

1. Output Analog: 4-20 milliamps
2. Output Digital: Digital process variable, configuration and diagnostic data superimposed on 4-20 milliamps output signal, available to any host communicator that conforms to the HART protocol, without interruption of the transmitter's output signal
3. Local Indication: None
4. Range: 0-300 psig
5. Minimum Span: (Upper Range Limit)/10 See Table "A"
6. Overpressure
Limit: 0 psia to 2,000 psig without damage to the transmitter
7. Reference
Accuracy: ± 0.1 percent of span for spans from 1:1 to 6:1 of Upper Range Limit. Between 6:1 and 10:1 of Upper Range Limit, accuracy = 0.15 percent of span or better
8. Stability: ± 0.1 percent of Upper Range Limit for six months

9. Ambient Temp.
Effect: At maximum span, zero error not to exceed ± 0.25 percent of span per 100 degrees Fahrenheit. The total effect including span and zero errors not to exceed ± 0.5 percent.
10. Damping: Analog output response user-selectable from 0 to 30 seconds minimum.
11. Failure Mode
Alarm: High (> 20 milliamps) output
12. Configuration
Memory: Non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption
13. Housing: NEMA 4
14. Enclosure Class: Non-Hazardous

D. Accessories:

1. Provide mounting bracket for mounting to 2 inch pipe.
2. Provide transmitter with 316 Stainless Steel drain/vent valves.
3. Provide Threaded Remote Diaphragm Seal Assembly:
 - a. Materials of Construction:

Seal Diaphragm -	316L Stainless Steel
Upper Seal Housing -	316 Stainless Steel
Mounting Ring -	316 Stainless Steel
Lower Seal Housing -	316 Stainless Steel
 - b. Fill Fluid: Silicone with temperature limits of minus 40 to plus 300 degrees Fahrenheit
 - c. Process Connection in
Lower Seal Housing: 1-inch NPT female with a flushing connection
 - d. Capillary Connection in
Upper Seal Housing: 1/2-20 UNF female
 - e. Capillary Connection in
Transmitter: 1/2-20 UNF female
4. Provide capillary tubing:
 - a. Material: 316 Stainless Steel
 - b. Size: 0.028-inch inside diameter
 - c. Fitting Size Transmitter
End: 1/2 UNF Low-Volume male
 - d. Fitting Size Upper Seal
Housing End: 1/2 UNF Low-Volume male

- e. Length: 60-inches
- f. Protective Sleeving: Armored 300 Series Stainless Steel
- g. Transmitter Connection: Connected to high pressure side; all trapped air must be removed from capillary tube and fill fluid

2.02 SOURCE QUALITY CONTROL

A. Factory Tests and Calibration:

1. Manufacturer shall test and calibrate pressure transmitter elements to assure conformance to listed specifications prior to shipment. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

2.03 ACCEPTABLE MANUFACTURERS

- A. ABB Kent-Taylor
- B. Bailey/Fischer & Porter
- C. Rosemount

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

Attachment - TABLE "A", 1 page

TABLE "A"

Pressure Transmitters

Tag No.	Service	Process Fluid	4ma to 20ma Span
PT-110	Pumping Well PW-110 Outlet Pressure	Groundwater	0 - 50 psig
PT-120	Pumping Well PW-120 Outlet Pressure	Groundwater	0 - 50 psig
PT-130	Pumping Well PW-130 Outlet Pressure	Groundwater	0 - 50 psig
PT-140	Pumping Well PW-140 Outlet Pressure	Groundwater	0 - 50 psig
PT-401A	GAC F-801 Inlet Influent Pressure	Groundwater	0 - 50 psig
PT-401B	GAC F-801 Outlet Effluent Pressure	Groundwater	0 - 50 psig
PT-402A	GAC F-802 Inlet Influent Pressure	Groundwater	0 - 50 psig
PT-402B	GAC F-802 Outlet Effluent Pressure	Groundwater	0 - 50 psig
PT-403A	GAC F-803 Inlet Influent Pressure	Groundwater	0 - 50 psig
PT-403B	GAC F-803 Outlet Effluent Pressure	Groundwater	0 - 50 psig

SECTION 13427

LEVEL TRANSMITTER - RADIO FREQUENCY/IMPEDANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of electronic continuous level transmitter based on the Radio Frequency (RF)/impedance measurement technique and auxiliary equipment, options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)
- B. ANSI - ANSI 16.5-81 Pipe Flanges and Flanged Fittings

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per transmitter) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.

6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.
7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The level transmitter shall consist of a sensor probe with a remote electronic transmitter and shall be capable of measuring liquid level continuously over the specified range.

B. Sensor:

1. The level sensor probe design shall use the concept of a variable RF impedance when the probe is in contact with a liquid. The probe shall function regardless of the liquid's dielectric, conductivity or viscosity.

C. Electronic Transmitter:

1. The electronic transmitter shall convert the sensor variable RF impedance related to the process level measurement, in linear proportion, to a 4 to 20 milliamps DC output signal capable of transmission into at least a 600 ohm load. Signal output shall be provided on a single pair of wires.
2. Transmitter functions shall be controlled by a microprocessor. Transmitter shall include a non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption.
3. Transmitter shall be capable of superimposing a digital communication signal utilizing the Highway Addressable Remote Transducer (HART) protocol on the 4-20 milliamps DC signal for interrogation, configuration, and diagnostics with a HART host communicator device without interruption of the transmitter's output signal. As a minimum, the transmitter shall be capable of implementing the Universal and Common-Practice Commands as defined in the HART protocol.

1.05 WARRANTY

- ##### A. Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No.: See TABLE "A" (Attachment A)
2. Power Supply: 120 Volts AC plus or minus 10 percent, 50/60 Hz, single-phase
3. Operating Temp. Limits: Minus 40 to plus 140 degrees Fahrenheit
4. Humidity Limits: 10-100 percent relative humidity

B. Sensor Element:

1. Type: See TABLE "A"
2. Material: Wetted parts Type 304 stainless steel and teflon per manufacturer's standards
3. Sensor Element Probe Length: See TABLES "A" and "B" and FIGURES 1 thru 20
4. Mounting Connection: Flanged and Non-flanged, see Table "A" note 4

C. Transmitter:

1. Output Analog: 4-20 milliamps
2. Local Indication: Digital Alpha-Numeric Liquid Crystal display
3. Range: See TABLE "A"
4. Calibrated Span: See TABLE "A"
5. Accuracy: Plus or minus 0.5 percent of span or better
6. Stability: Plus or minus 0.015 percent per degree Fahrenheit or better;
7. Response Time: 20 milliseconds or better
8. Level Control Adjustment: Span adjustable 0 to 100 percent full range
Zero adjustable 0 to 10 percent of full range
9. Damping: Adjustable output damping of 0 to 10 seconds minimum
10. Failure Mode Alarm: High (> 20 milliamps) output
11. Configuration Memory: Non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption
12. Housing: NEMA 4
13. Enclosure Class: Non-Hazardous

14. Location: Remotely located from sensor element

D. Service Conditions:

1. Process Fluid: Groundwater
2. Maximum Process Pressure: See TABLE "A"
3. Agitation: See TABLE "A"
4. Well Casing and Tank Vessel Material: See TABLE "A"

E. Accessories:

1. Provide sensor remote connection cable. For length See TABLE "A".
2. Provide sensor connection head - NEMA 4.

2.02 SOURCE QUALITY CONTROL

A. Factory Tests and Calibration:

1. Manufacturer shall test and calibrate level transmitter elements to assure conformance to listed specifications prior to shipment. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

2.03 ACCEPTABLE MANUFACTURERS

- A. Drexelbrook
- B. Fisher & Porter
- C. Princo Instrument

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

Attachment A - TABLE "A", 3 pages
Attachment B - TABLE "B", 2 pages
Attachment C - FIGURES 1 thru 20, 20 pages

TABLE "A"

Level Transmitters

Tag No.	Service	Sensor Element Type and Probe Length feet	Range inches	Transmitter Output 4 to 20 mA Span inches	Maximum Process Pressure psig	Agitation Horsepower	Size of Well Riser (Size/Material)	Remote Sensor Cable Length feet
LIT-110A	Water Level in Pumping Well PW-110 (Figure 1)	Flexible Sensor Cable, No Flange 10.0' Long	120	0 to 96	10	3	6" Diameter, Stainless Steel	50
LIT-110B	Water Level in Monitoring Well MW-110 (Figure 2)	Flexible Sensor Cable w/Ground, 2" Flange 11.0' Long	132	0 to 96	10	No Agitation	2" Diameter, PVC	50
LIT-110C	Water Level in Stream Well SW-110 (Figure 3)	Flexible Sensor Cable, 2" Flange 13.0' Long	156	0 to 96	10	No Agitation	2" Diameter, Stainless Steel	50
LIT-120A	Water Level in Pumping Well PW-120 (Figure 4)	Flexible Sensor Cable, No Flange 10.0' Long	120	0 to 96	10	0.75	6" Diameter Stainless Steel	50
LIT-120B	Water Level in Monitoring Well MW-120 (Figure 5)	Flexible Sensor Cable w/Ground, 2" Flange 11.0' Long	132	0 to 96	10	No Agitation	2" Diameter PVC	50
LIT-120C	Water Level in Stream Well SW-120 (Figure 6)	Flexible Sensor Cable, 2" Flange 12.0' Long	144	0 to 96	10	No Agitation	2" Diameter Stainless Steel	50
LIT-130B	Water Level in Monitoring Well MW-130 (Figure 7)	Flexible Sensor Cable, 1-1/4" Flange, 2.0' Long	144	0 to 96	10	No Agitation	1-1/4" Diameter Carbon Steel	50
LIT-130C	Water Level in Stream Well SW-130 (Figure 8)	Flexible Sensor Cable, 2" Flange 13.0' Long	156	0 to 96	10	No Agitation	2" Diameter Stainless Steel	50

TABLE "A"

Level Transmitters

Tag No.	Service	Sensor Element Type and Probe Length feet	Range inches	Transmitter Output 4 to 20 mA Span inches	Maximum Process Pressure psig	Agitation Horsepower	Size of Well Riser (Size/Material)	Remote Sensor Cable Length feet
LIT-130A	Water Level in Pumping Well PW-130 (Figure 9)	Flexible Sensor Cable, No Flange 13.0' Long	156	0 to 96	10	0.75	6" Diameter, Stainless Steel	50
LIT-140A	Water Level in Pumping Well PW-140 (Figure 10)	Flexible Sensor Cable, No Flange 13.0' Long	156	0 to 96	10	0.75	6" Diameter, Stainless Steel	50
LIT-2SA	Water Level in Monitoring Well MW-2S (Figure 11)	Flexible Sensor Cable, 4" Flange 10.5' Long	126	0 to 96	10	No Agitation	4" Diameter, Stainless Steel	50
LIT-2SB	Water Level in Monitoring Well P-2S (Figure 12)	Flexible Sensor Cable, 1-1/4" Flange, 9.5' Long	114	0 to 96	10	No Agitation	1-1/4" Diameter, Stainless Steel	50
LIT-3S	Water Level in Monitoring Well MW-3S (Figure 13)	Flexible Sensor Cable, 4" Flange 13.0' Long	156	0 to 96	10	No Agitation	4" Diameter, Stainless Steel	50
LIT-10S	Water Level in Monitoring Well MW-10S (Figure 14)	Flexible Sensor Cable, 4" Flange 13.5' Long	162	0 to 96	10	No Agitation	4" Diameter, Stainless Steel	50
LIT-36S	Water Level in Monitoring Well P-36S (Figure 15)	Flexible Sensor Cable w/Ground, 2" Flange, 12.0' Long	144	0 to 96	10	No Agitation	2" Diameter, PVC	50
LIT-10D	Water Level in Monitoring Well MW-10D (Figure 16)	Flexible Sensor Cable, 4" Flange 13.5' Long	162	0 to 96	10	No Agitation	4" Diameter, Stainless Steel	50

TABLE "A"

Level Transmitters

Tag No.	Service	Sensor Element Type and Probe Length feet	Range inches	Transmitter Output 4 to 20 mA Span inches	Maximum Process Pressure psig	Agitation Horsepower	Size of Vessel (Size/Material)	Remote Sensor Cable Length feet
LIT-200	Water Level in Equalization Tank, T-200 (Figure 17)	Flexible Sensor Cable, 4" Flange 14.0' Long	168	0 to 144	10	1	6' Diameter, Stainless Steel	50
LIT-300	Water Level in Backwash Tank, T-300 (Figure 18)	Flexible Sensor Cable, 4" Flange 16.0' Long	192	0 to 156	10	No Agitation	11' Diameter, Stainless Steel	50
LIT-500	Water Level in pH Adjustment Tank, T-500 (Figure 19)	Rigid Heavy Duty Dual Probe, 4" Flange 9.0' Long	108	0 to 96	10	0.75	8' Diameter, Stainless Steel	50
LIT-710	Water Level in Free Product Storage Tank, T-710 (Figure 20)	Rigid Heavy Duty Dual Probe, 4" Flange, 6.0' Long	72	0 to 60	10	No Agitation	6' Diameter, Stainless Steel	50

Notes:

1. Flexible probe cable to have the standard end weight.
2. See TABLE "B" and FIGURES 1 thru 20 for detailed dimensional information.
3. Level sensors are mounted in vertical axis.
4. Sensors designated as non-flanged to have manufacturer's standard pipe threaded double-ended mounting adapter. "End Weight" and ground reference components shall be constructed to easily pass through a pipe fitting equivalent in size to the threaded double-ended mounting adapter.
5. Sensors to have cable/probe connection head, NEMA 4.
6. All flexible sensing cables are to have end weights.

TABLE "B"

Level Sensor Dimensional Information

Tag No.	Well/Tank Description	Dimension "A" feet	Dimension "B" feet	Dimension "C" inches	Dimension "D" feet	Dimension "E" feet	Dimension "F" feet
LIT-110A	Water Level in Pumping Well PW-110	38.33	17.78	2	36.73	28.73	28.33
LIT-110B	Water Level in Monitoring Well MW-110	18.50	16.10	1	16.15	8.15	7.50
LIT-110C	Water Level in Stream Well SW-110	38.01	17.07	1	33.30	25.30	25.01
LIT-120A	Water Level in Pumping Well PW-120	48.33	17.62	2	46.86	38.86	38.33
LIT-120B	Water Level in Monitoring Well MW-120	18.13	15.73	1	15.68	7.68	7.13
LIT-120C	Water Level in Stream Well SW-120	29.91	16.68	1	26.24	18.24	17.91
LIT-130B	Water Level in Monitoring Well MW-130	13.41	17.14	5/8	9.54	1.54	1.41
LIT-130C	Water Level in Stream Well SW-130	37.41	17.11	1	32.74	24.74	24.41
LIT-200	Water Level in Equalization Tank, T-200	16.33	0.50	36	14.33	2.33	2.33
LIT-300	Water Level in Backwash Tank, T-300	17.83	0.50	66	14.83	1.83	1.83

TABLE "B"

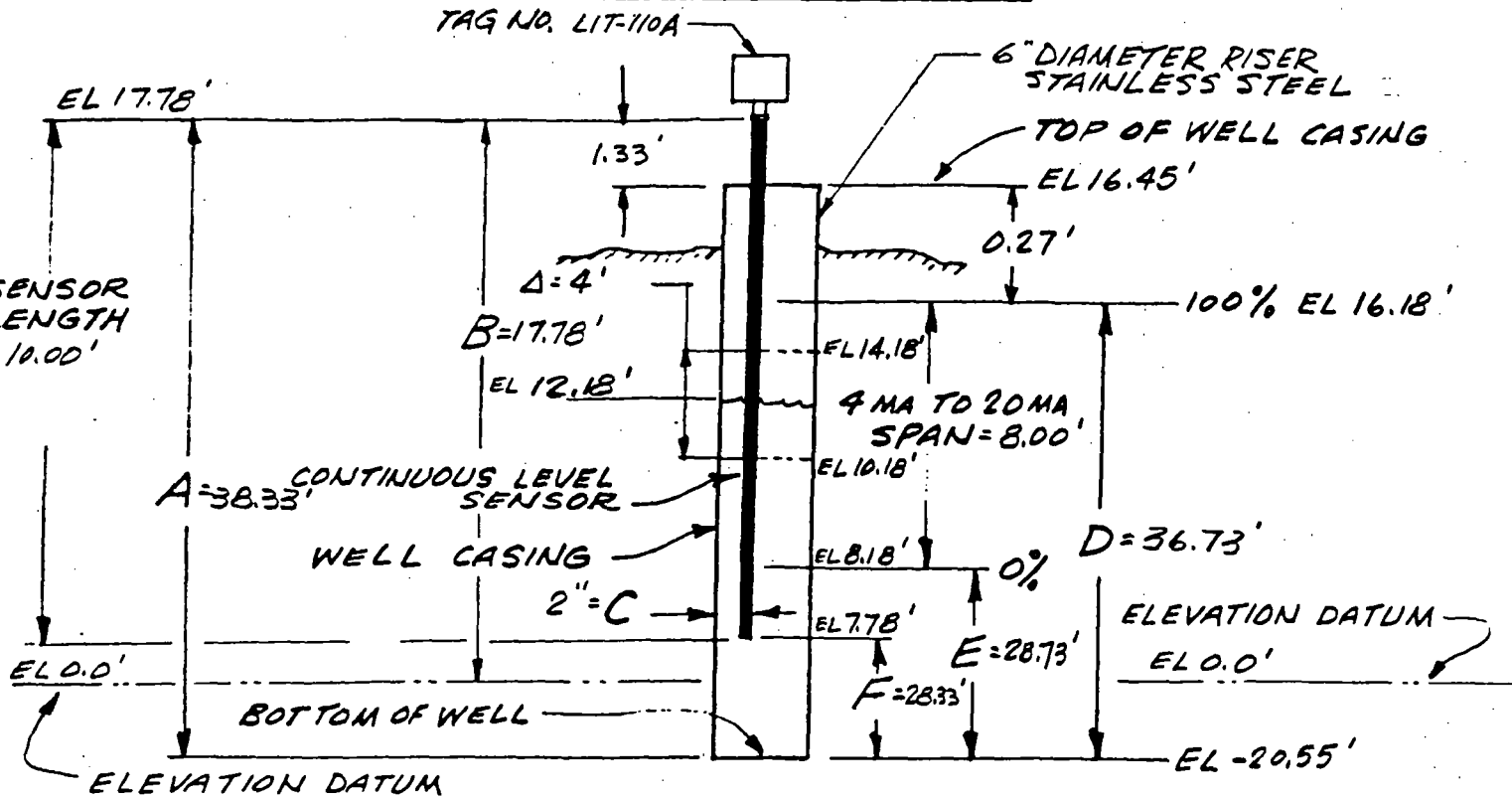
Level Sensor Dimensional Information

Tag No.	Well Description	Dimension "A" feet	Dimension "B" feet	Dimension "C" inches	Dimension "D" feet	Dimension "E" feet	Dimension "F" feet
LIT-130A	Water Level in Pumping Well PW-130	37.79	17.24	2	33.25	25.25	24.79
LIT-140A	Water Level in Pumping Well PW-140	37.84	17.78	2	33.85	25.85	25.33
LIT-2SA	Water Level in Monitoring Well MW-2S	20.43	14.93	2	18.10	10.10	9.93
LIT-2SB	Water Level in Monitoring Well P-2S	10.52	14.23	5/8	9.44	1.44	1.02
LIT-3S	Water Level in Monitoring Well MW-3S	20.47	17.14	2	15.74	7.44	7.47
LIT-10S	Water Level in Monitoring Well MW-10S	22.79	23.09	2	17.76	9.76	9.29
LIT-36S	Water Level in Monitoring Well P-36S	18.82	16.32	1	15.28	7.28	6.82
LIT-10D	Water Level in Monitoring Well MW-10D	47.78	22.08	2	42.76	34.76	34.28
LIT-500	Water Level in pH Adjustment Tank, T-500	11.08	0.50	48	10.08	2.08	2.08
LIT-710	Free Product Storage Tank, T-710	7.50	0.50	36	6.50	1.50	1.50

Note:

1. Refer to FIGURES 1 thru 20 for illustrations of well dimensions.

CONTINUOUS LEVEL SENSOR WELL DIMENSIONS



WELL DIMENSIONS PUMPING WELL PW-110

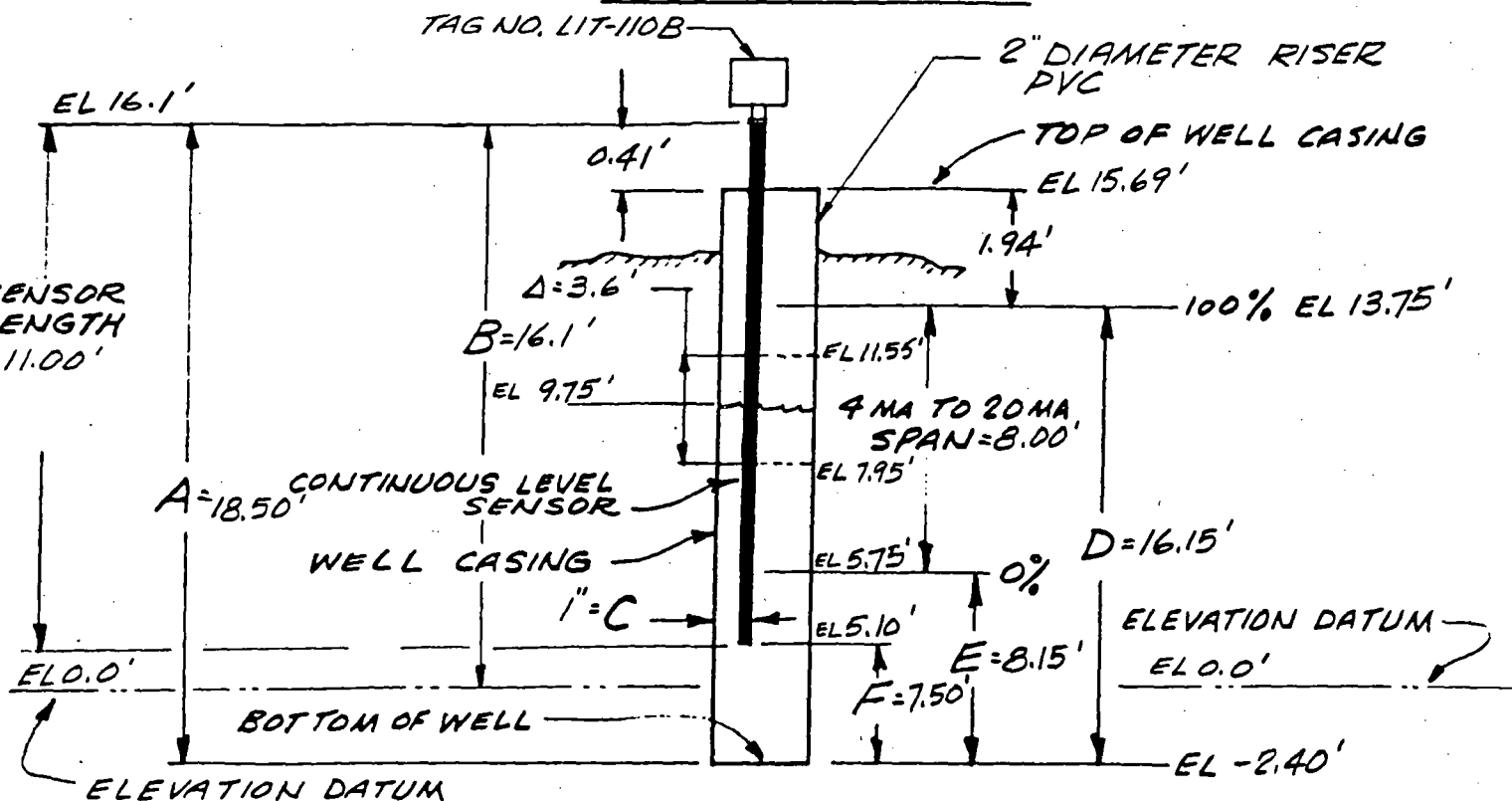
FIGURE 1

CIBA
SPECS\CRANSTON\13427.00
NOVEMBER 1, 1994

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-C1

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS



WELL DIMENSIONS MONITORING WELL MW-110

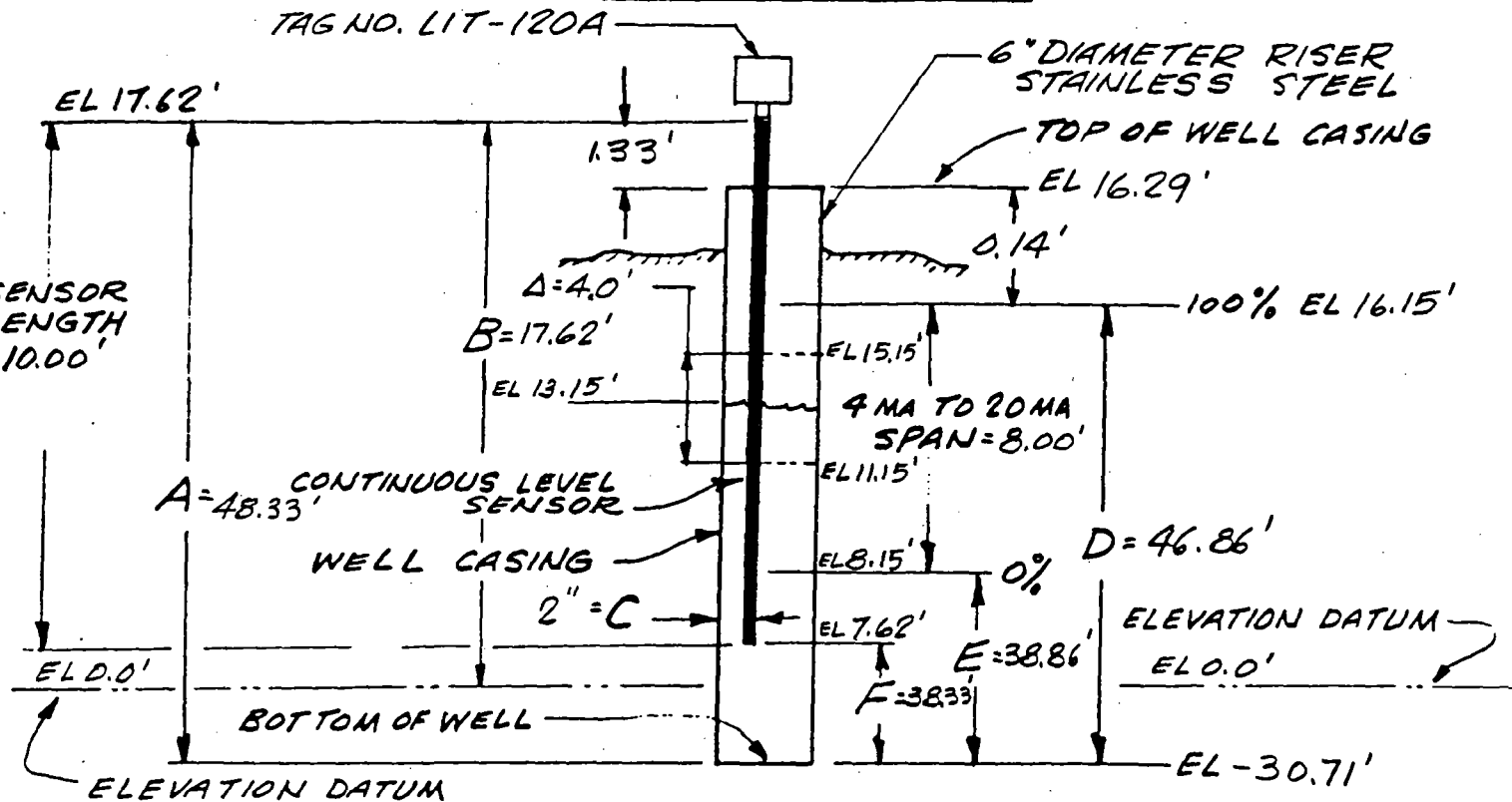
FIGURE 2

CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C2

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS



WELL DIMENSIONS PUMPING WELL PW-120

FIGURE 4

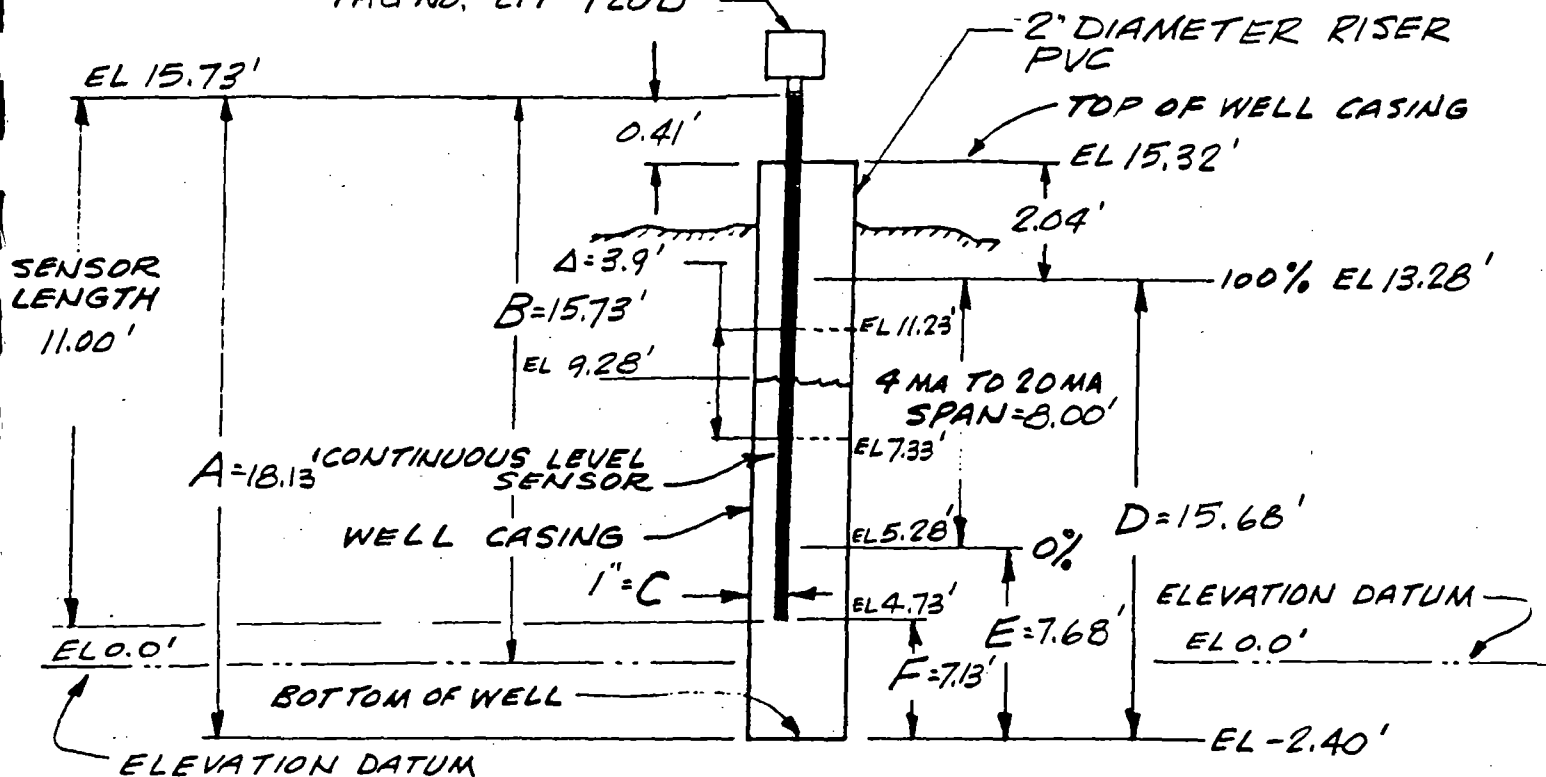
CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C4

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS

TAG NO. LIT-120B



WELL DIMENSIONS

MONITORING WELL MW-120

FIGURE 5.

CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

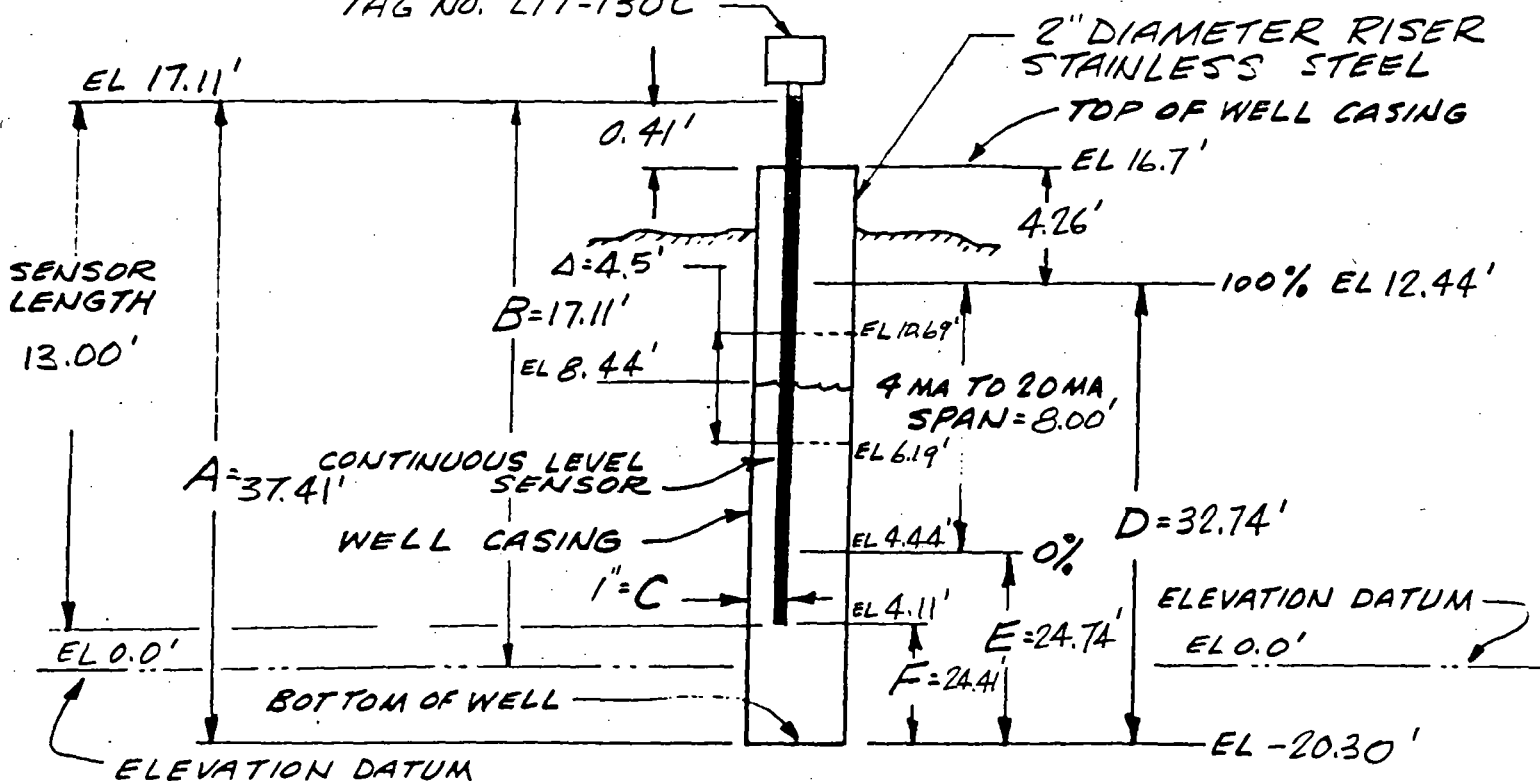
LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C5

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-C7

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS

TAG NO. LIT-130C



WELL DIMENSIONS STREAM WELL SW-130

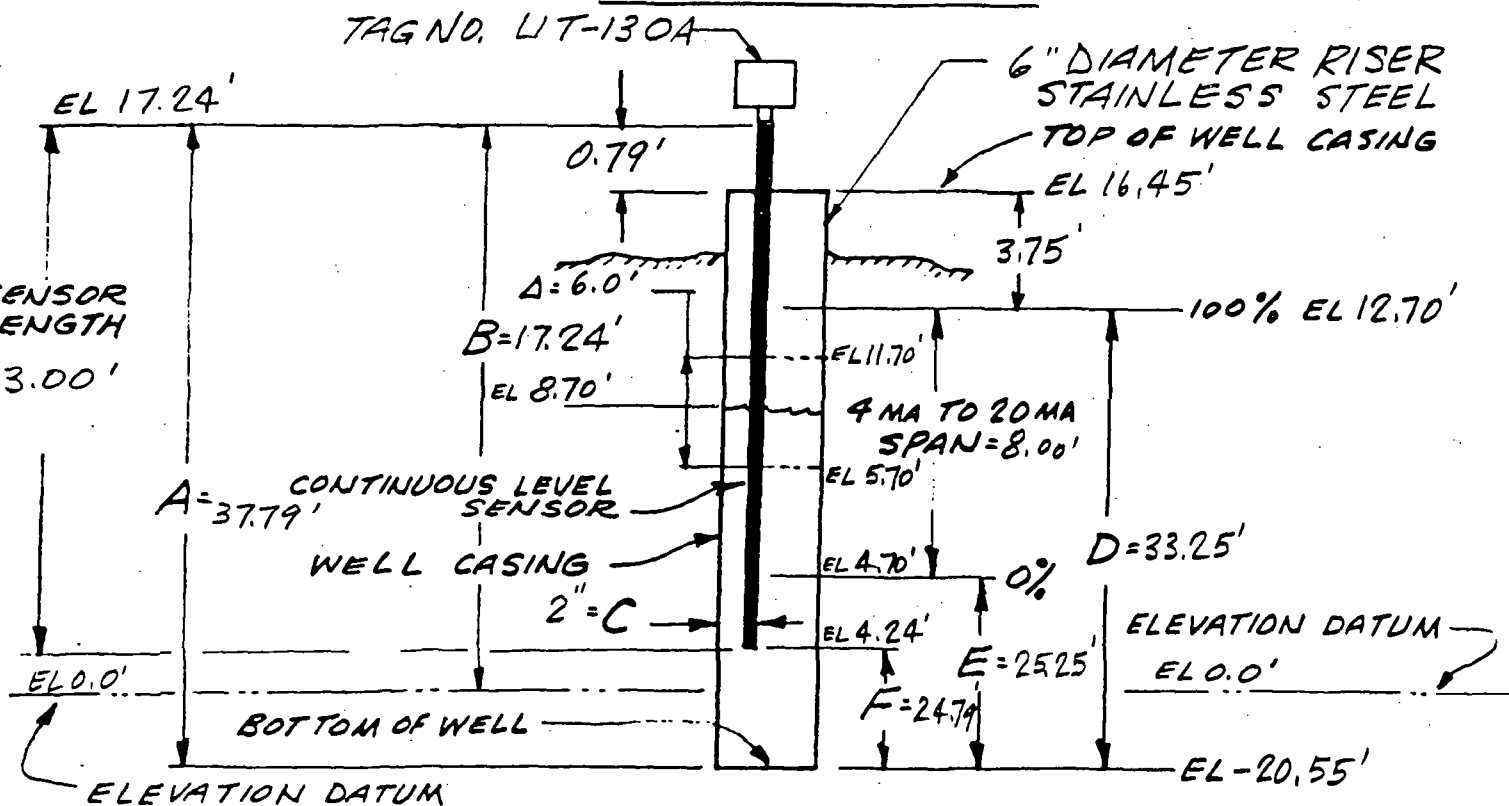
FIGURE 8

CIBA
SPECS \ CRANSTON \ 13427.00
NOVEMBER 1, 1994

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-CB

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS



WELL DIMENSIONS

PUMPING WELL PW-130

FIGURE 9.

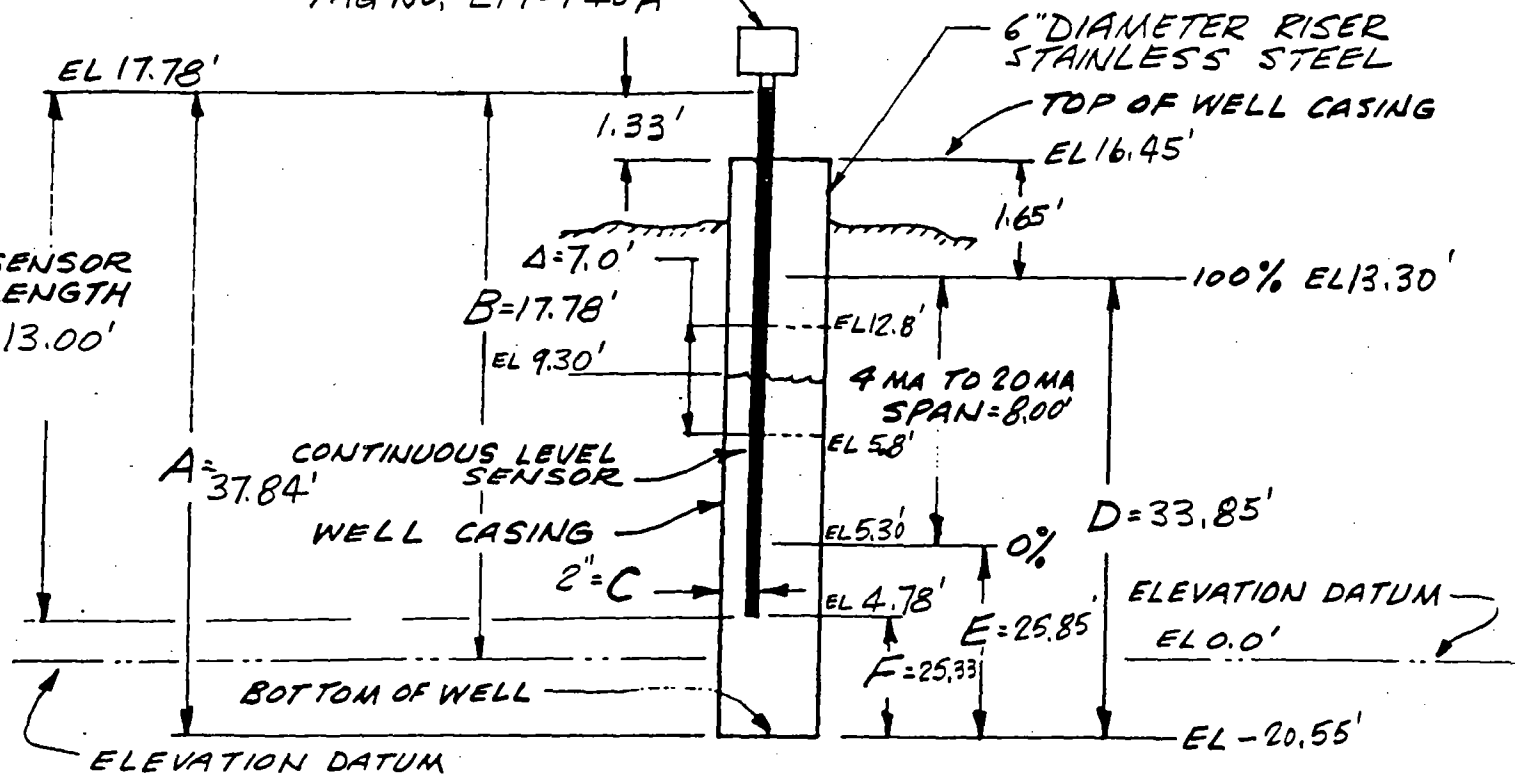
CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C9

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS

TAG NO. LIT-140A



WELL DIMENSIONS

PUMPING WELL PW-140

FIGURE 10.

CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

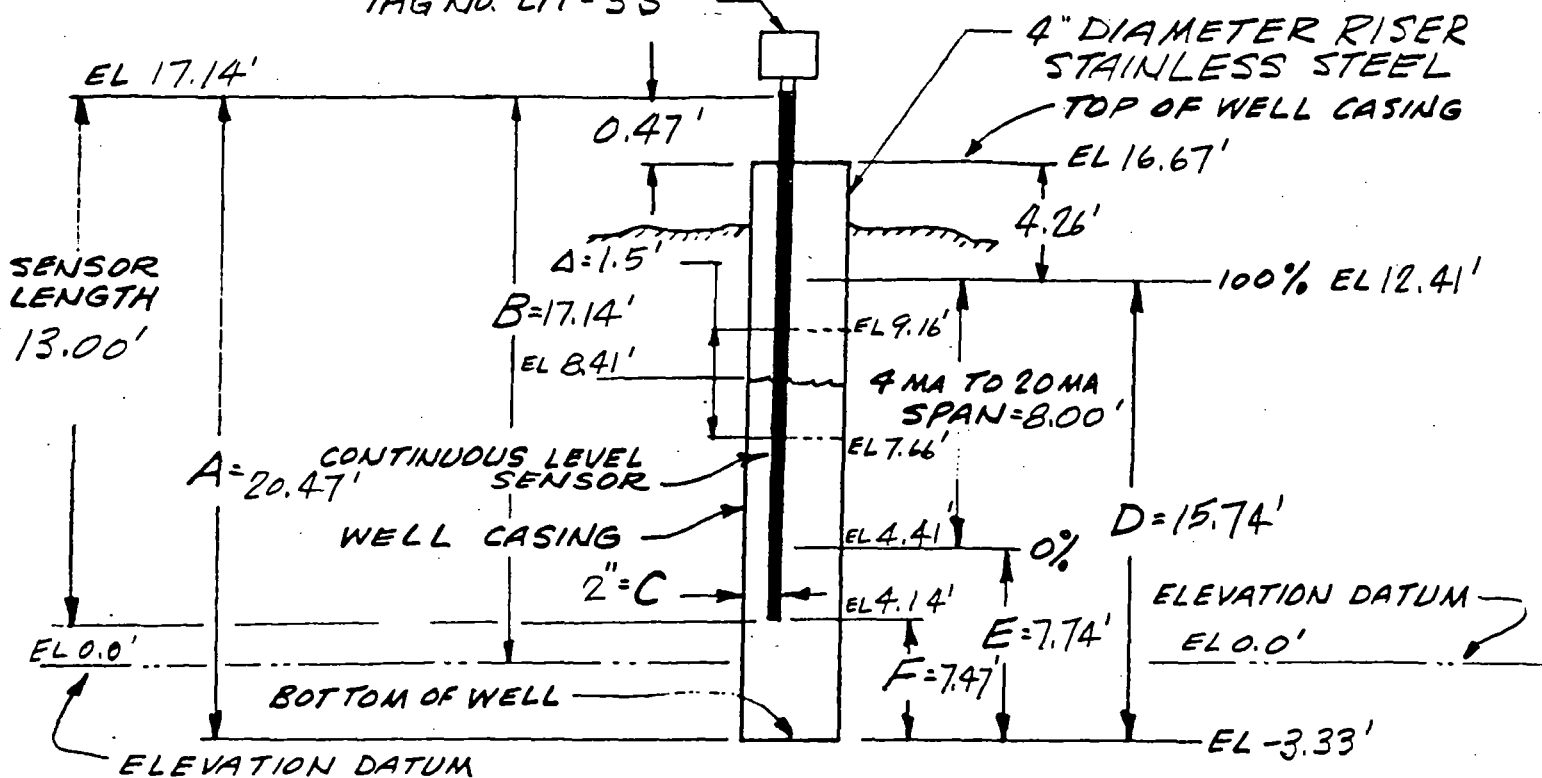
LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C10

FIGURE 12.

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS

TAG NO. LIT-3S



WELL DIMENSIONS

MONITORING WELL MW-3S

FIGURE 13

CIBA
 SPECS\CRANSTON\13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C13

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS

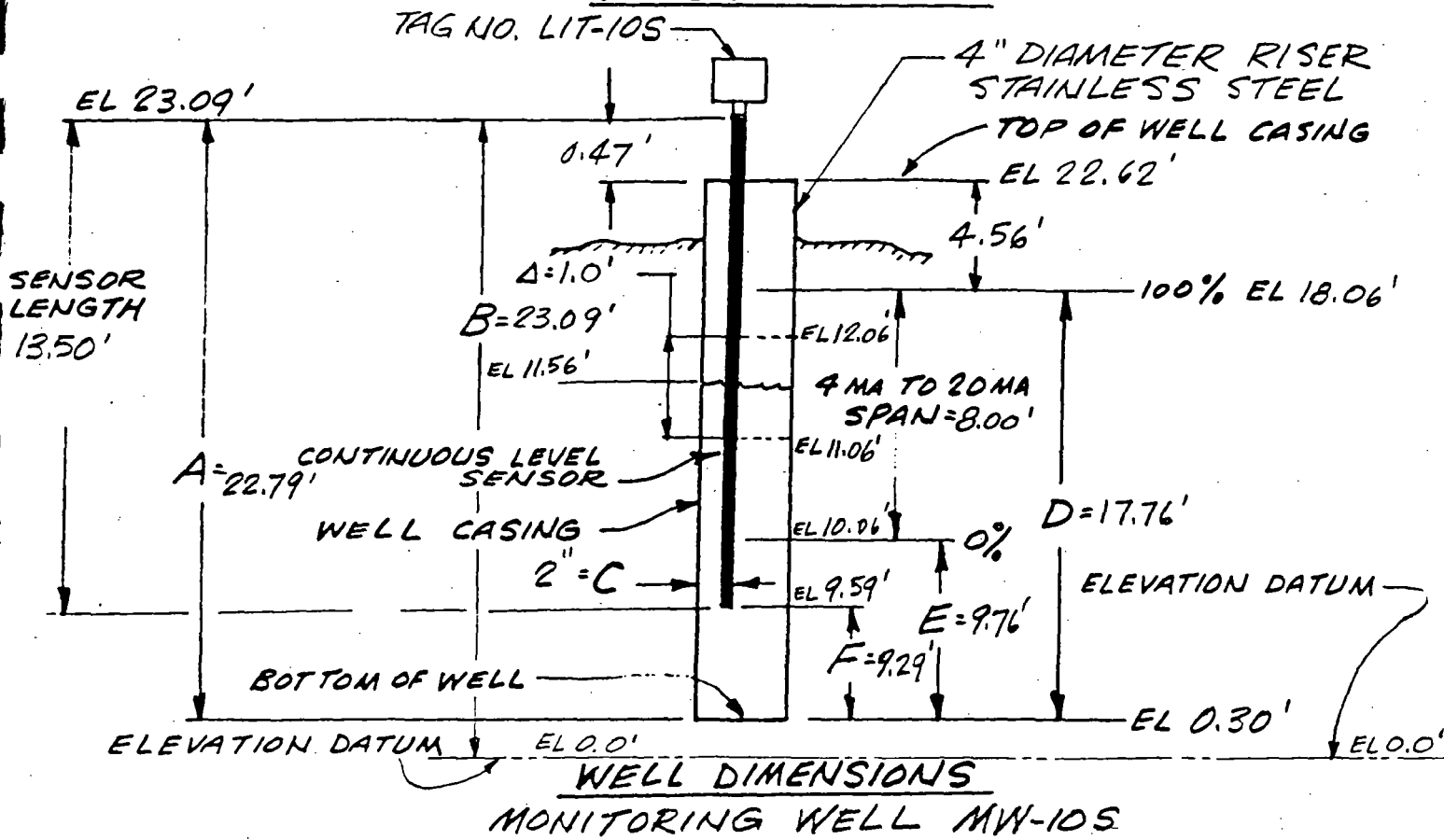


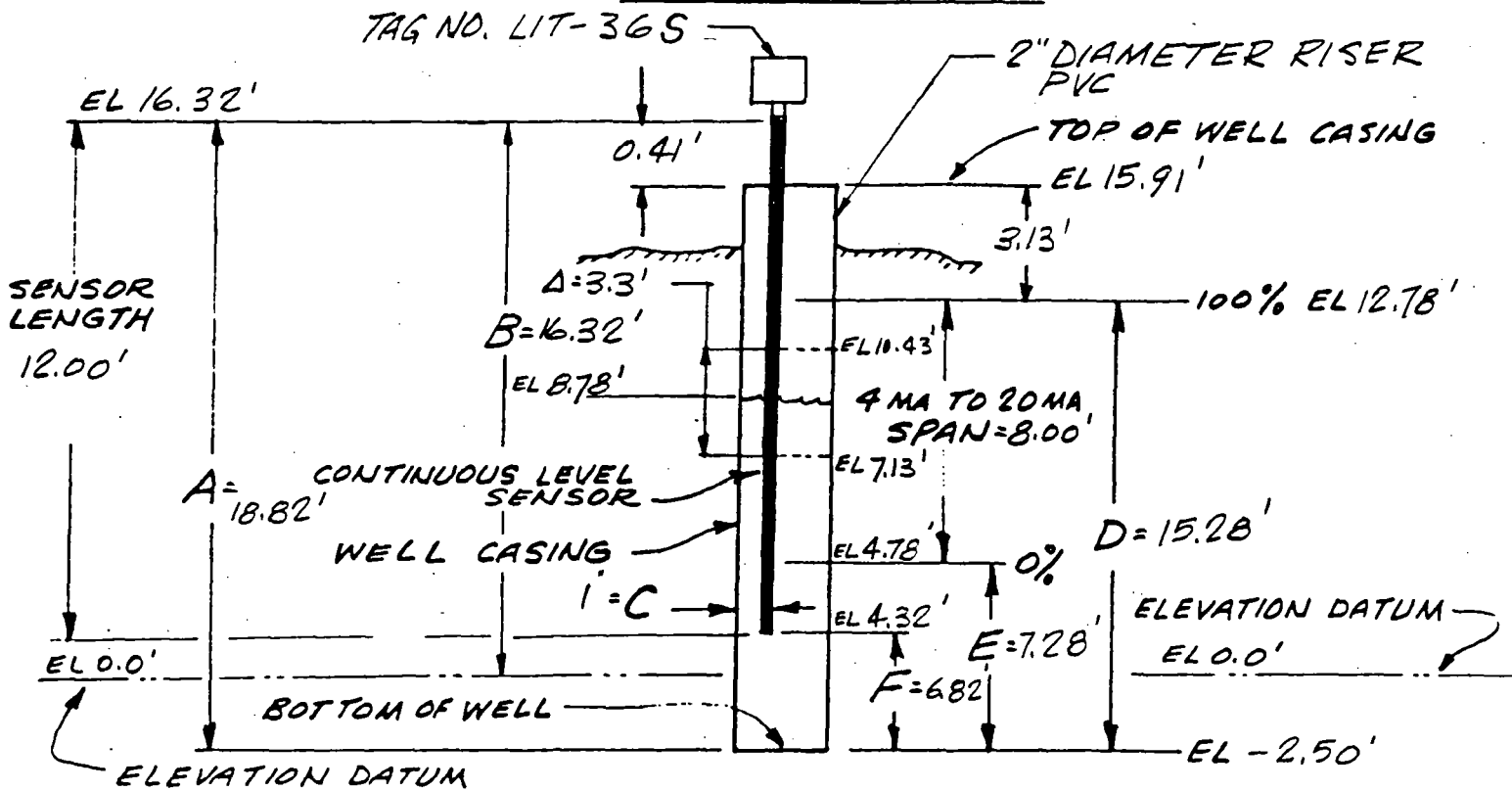
FIGURE 14

CIBA
 SPECS\CRANSTON\13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C14

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS



WELL DIMENSIONS

MONITORING WELL P36S

FIGURE 15

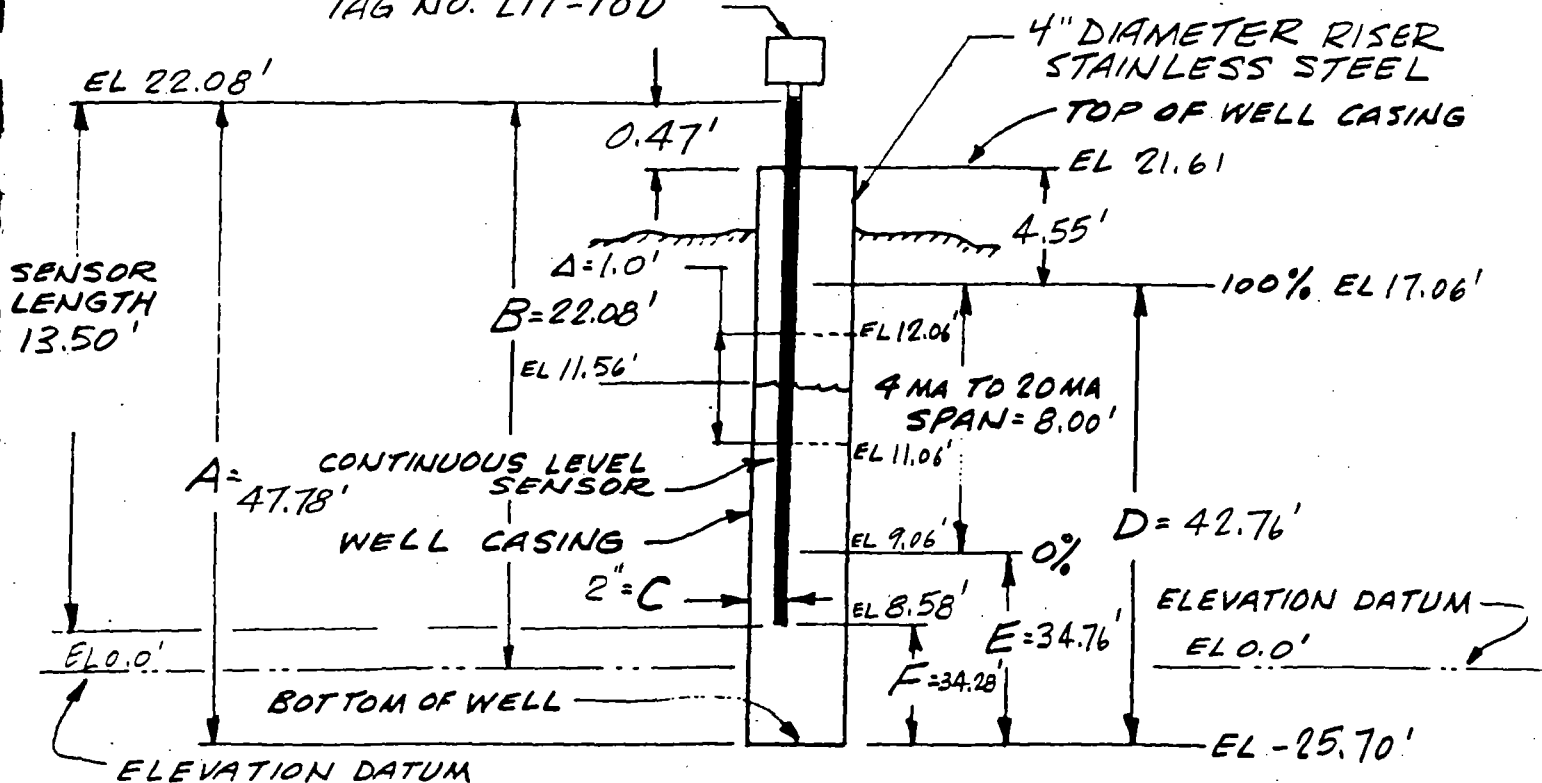
CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C15

CONTINUOUS LEVEL SENSOR

WELL DIMENSIONS

TAG NO. LIT-10D



WELL DIMENSIONS

MONITORING WELL MW-10D

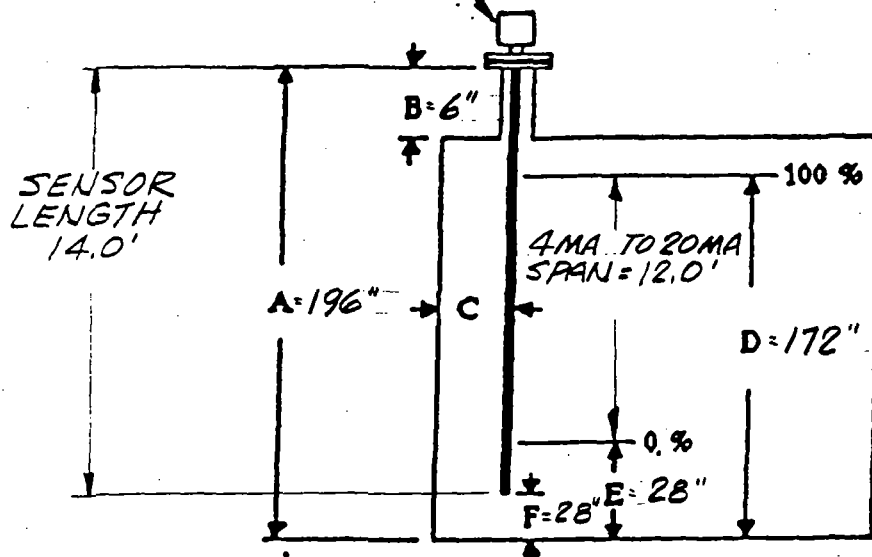
FIGURE 16

CIBA
 SPECS \ CRANSTON \ 13427.00
 NOVEMBER 1, 1994

LEVEL TRANSMITTER
 CONTINUOUS LEVEL SENSOR ELEMENT
 13427-C16

CONTINUOUS LEVEL SENSOR
TANK DIMENSIONS

TAG NO. LIT-200



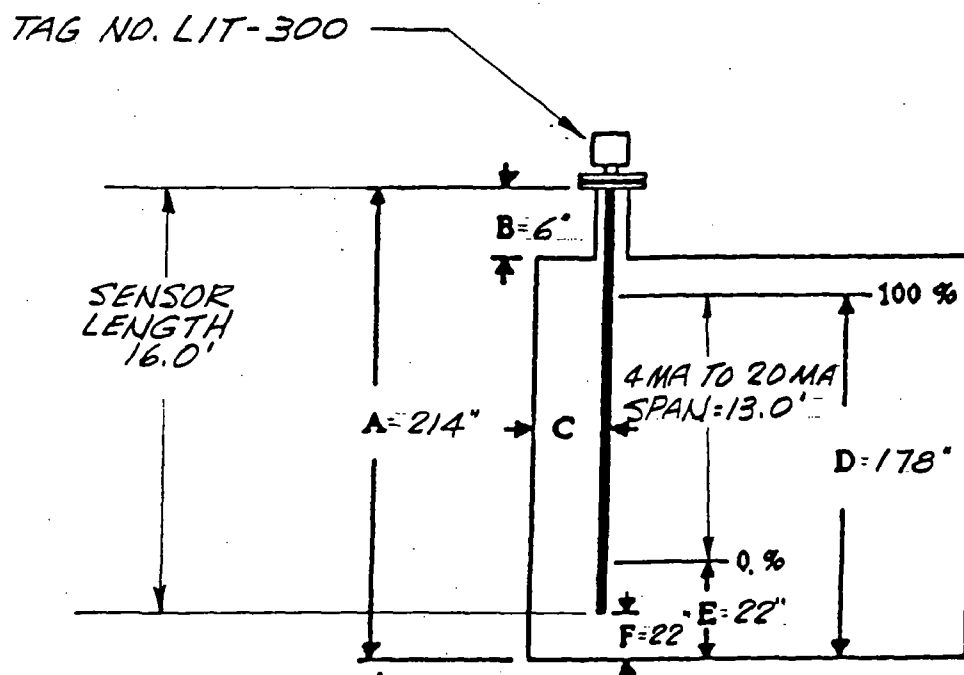
TANK DIMENSIONS
EQUALIZATION TANK
T-200

FIGURE 17

CIBA
SPECS CRANSTON 13427.00
JANUARY 26, 1995

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-C17

CONTINUOUS LEVEL SENSOR
TANK DIMENSIONS



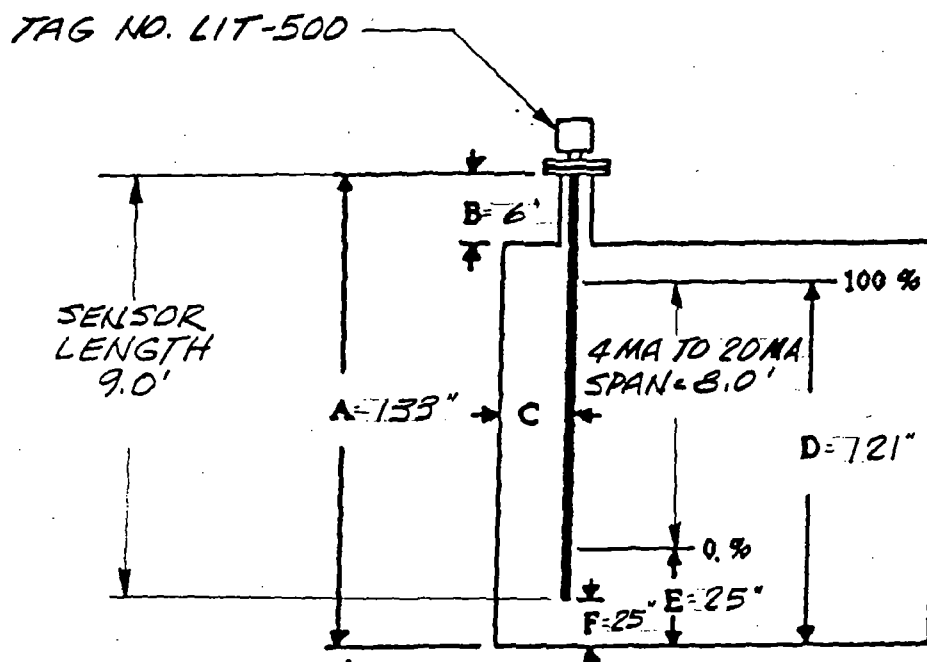
TANK DIMENSIONS
BACKWASH TANK
T-300

FIGURE 18

CIBA
SPECS CRANSTON 13427.00
JANUARY 26, 1995

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-C18

CONTINUOUS LEVEL SENSOR
TANK DIMENSIONS



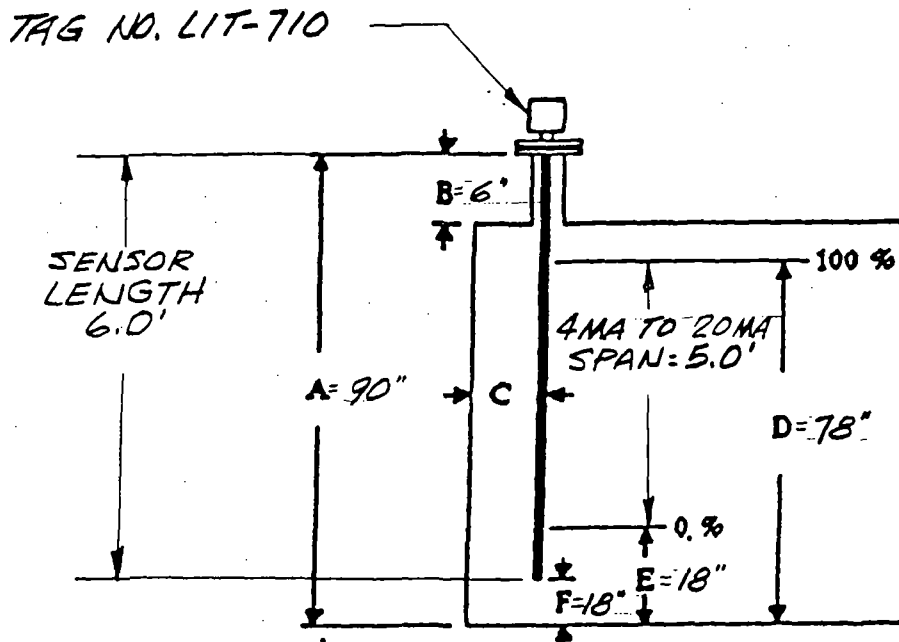
TANK DIMENSIONS
FINAL pH ADJUSTMENT TANK
T-500

FIGURE 19

CIBA
SPECS CRANSTON 13427.00
JANUARY 26, 1995

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-C19

CONTINUOUS LEVEL SENSOR
TANK DIMENSIONS



TANK DIMENSIONS
FREE PRODUCT STORAGE TANK
T-710

FIGURE 20

CIBA
SPECS CRANSTON 13427.00
JANUARY 26, 1995

LEVEL TRANSMITTER
CONTINUOUS LEVEL SENSOR ELEMENT
13427-C20

SECTION 13428

SINGLE POINT LEVEL SWITCH

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of an electronic on/off point level switch based on the Radio Frequency (RF)/impedance measurement technique and auxiliary equipment, options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per level switch) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.
 - 6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.

7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The single point level switch shall consist of a sensing probe with an integral electronic controller to detect the presence or absence of a liquid and provide a switchable output contact which is activated at a selectable point along the sensing probe length.

B. Sensor:

1. The level sensor probe design shall use the concept of variable RF impedance when the probe is in contact with a liquid.

C. Electronic Controller:

1. The electronic controller shall convert the sensor variable RF impedance related to the process level measurement to an electronic signal and compare this signal to an adjustable level setpoint. Upon reaching the setpoint, the controller shall cause a change in an internal output relay logic state.
2. The controller shall contain, as a minimum, adjustments for coarse and fine sensitivity, dead band, and relay activation time delay.
3. The controller shall incorporate a self-diagnostic test, which can be initiated locally or by a remote computer, to check all functional stages of the controller including probe status, sensing electronics, and the output control relay.

1.05 WARRANTY

- ##### A. Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No: See TABLE "A" (Attachment)
2. Power Supply: 120 Volts AC plus or minus 10 percent, 50/60 Hz, single-phase
3. Operating Temp. Limits: Minus 40 to plus 140 degrees Farenheit
4. Humidity Limits: 10-100 percent relative humidity

B. Sensor Probe:

1. Material: 316 Stainless Steel
2. Insertion length: See TABLE "A"

3. Mounting
Connection: 3/4-inch NPT
4. Orientation: See TABLE "A"

C. Controller:

1. Location: Mounted on probe
2. Adjustable
Response Time: 0 to 30 seconds minimum
3. Delay Mode: Delay in both directions (turn-on and turn-off)
4. Failure Mode: Field adjustable to either high or low level
5. Sensitivity: 0.2 picofarad minimum
6. Stability:
 - a. Temperature: Plus or minus 0.003 picofarad per degree Fahrenheit
 - b. Line Voltage: Plus or minus 0.25 percent per 20 volts
7. Output relay: Double pole, double throw
 - a. Contact rating: 120 Volts AC; 5 Amperes non-inductive, 3 Amperes inductive
8. Enclosure: NEMA 4
9. Conduit
Connection: 1-inch NPT

D. Service Conditions:

1. Process Material: See TABLE "A"
2. Maximum Process
Pressure: See TABLE "A"
3. Agitation: See TABLE "A"
4. Vessel material: See TABLE "A"

E. Accessories:

1. Provide 4-inch ANSI 150# type 316 stainless steel mounting flange for each sensor probe.

2.02 SOURCE QUALITY CONTROL

A. Factory Tests and Calibration:

1. Manufacturer shall test and calibrate single point level switch elements to assure conformance to listed specifications prior to shipment.

2.03 ACCEPTABLE MANUFACTURERS

- A. Drexelbrook
- B. Fisher & Porter
- C. Great Lakes Instruments

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

Attachment - TABLE "A", 1 page

TABLE "A"

Single Point Level Switches

Tag No.	Service	Orientation of Level Switch Probe	Probe Insertion Length inches	Maximum Process Pressure psig	Agitation Horsepower	Process Material	Vessel Material
LS-200	High Water Level in Equalization Tank, T-200	Vertical Axis	24	Atmospheric	1	Groundwater	Stainless Steel
LS-300	High Water Level in Backwash Tank, T-300	Vertical Axis	27	Atmospheric	No Agitation	Groundwater	Stainless Steel
LS-500	High Water Level in pH Adjustment Tank, T-500	Vertical Axis	24	Atmospheric	0.75	Groundwater	Stainless Steel
LS-710	High Fluid Level in Free Product Storage Tank, T-710	Vertical Axis	20	Atmospheric	No Agitation	Organic fluid	Stainless Steel

Note:

1. Sensor elements to have 4-inch ANSI 150# mounting flange, type 316 stainless steel.

SECTION 13429

CONTINUOUS LEVEL SENSOR - ULTRASONIC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of an ultrasonic continuous level sensor and auxiliary equipment, options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per level transmitter) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.
 - 6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service

7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The ultrasonic level sensor shall consist of a sensor with integral electronic transmitter and receiver capable of non-contact continuous measurement of liquid level in a closed polyethylene storage container.

B. Sensor:

1. The sensor shall be based on generation of a sonic signal and measurement of the reflected echo from the liquid surface.
2. Individual storage containers will each have a level sensor arranged as part of a system network.
3. Each sensor will be assembled to a screw cap mounted on top of the storage container (see Attachment B, Dwg. No. B-52075). The screw cap must be removeable without removal of the level sensor or unwiring of the power and communication cables.

Container size is approximately 42" wide x 48" long x 63" high. Individually stored liquids consist of hydrogen peroxide, sodium hydroxide, sulfuric acid, and a liquid polymer.

C. Sensor Electronics:

1. Liquid level sensor shall convert liquid level based on ultrasonic echo ranging measurement, in linear proportion, to a 4 to 20 mA dc isolated output signal capable of transmission into at least a 600 ohm load at 24V dc.
2. Sensor functions shall be controlled by a microprocessor. Sensor to be computer configurable and include a non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption.

1.05 WARRANTY

- ##### A. Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No: See TABLE "A" (Attachment)

2. Power Supply: 115 Volts AC plus or minus 10 percent, 50/60 Hz, single-phase
 3. Operating Temp. Limits: Plus 32 Fahrenheit to plus 122 degrees Fahrenheit
 4. Humidity Limits: 0-100 percent relative humidity
- B. Ultrasonic Sensor:
1. Material: All materials must withstand exposure to vapors, condensation, and an occasional "splash" of the storage container's liquid contents. See TABLE "A" for process liquid.
 2. Mounting Connection: Integral 2 inch NPT male threaded case
 3. Orientation: See TABLE "A"
 4. Operating Temp. Limits: Plus 32 Fahrenheit to plus 122 degrees Fahrenheit
 5. Humidity Limits: 0-100 percent relative humidity
 6. Process Pressure: See TABLE "A"
 7. Span: See TABLE "A"
 8. Electronics: Microprocessor based
 9. Display: Digital
 10. Resolution (Digital): 0.003384 inches
 11. Repeatability: Plus or minus 0.1 % of Span
 12. Enclosure: NEMA 4X
- C. Service Conditions:
1. Process Material: See TABLE "A"
 2. Maximum Process Pressure: See TABLE "A"
 3. Agitation: See TABLE "A"
 4. Storage container Material: See TABLE "A"
- D. Accessories:
1. Provide 115 VAC internal module.
 2. Output relays: Two quantity single pole, double throw relays, dry contact, Form C
 - a. Contact rating: 200 milliamperes to 5 Amperes @ 230 VAC or 30 VDC, non-inductive
 3. Tank display to have direct RS-422 data connection and NEMA 4X enclosure.
 4. Data converter adapter to convert RS-232 from the computer to RS-422 for long range communication.

5. Provide configuration software kit for adjusting sensor parameters.

2.02 SOURCE QUALITY CONTROL

A. Factory Tests and Calibration:

1. Manufacturer shall test and calibrate ultrasonic level transmitter elements to assure conformance to listed specifications prior to shipment. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

2.03 ACCEPTABLE MANUFACTURERS

A. Senix Corporation

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

(Attachment A - TABLE "A", 1 page)

(Attachment B - Dwg. No. B-52075, 1 page)

TABLE "A"

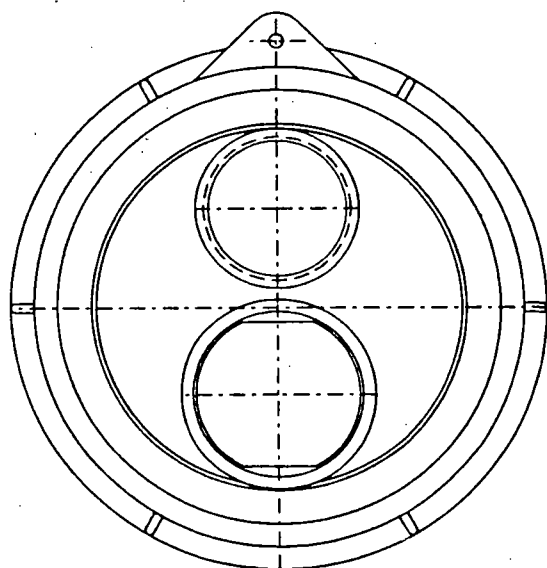
Level Transmitter - Ultrasonic

Tag No.	Service	Orientation of Ultrasonic Sensor	4ma (Low Level) to 20ma (High Level) Span	Maximum Process Pressure, psig	Agitation, Horsepower	Process Liquid	Storage Container Material
LT 520	Continuous Level Measurement for Detecting Low Level, Sodium Hydroxide Tote	Vertical Axis	4ma = 28 inches 20ma = 6 inches	Atmospheric	None	Sodium Hydroxide 25%	Medium Density Polyethylene
LT 220	Continuous Level Measurement for Detecting Low Level, Polymer Tote	Vertical Axis	4ma = 28 inches 20ma = 6 inches	Atmospheric	None	Polymer	Medium Density Polyethylene
LT 530	Continuous Level Measurement for Detecting Low Level, Sulfuric Acid Tote	Vertical Axis	4ma = 28 inches 20ma = 6 inches	Atmospheric	None	Sulfuric Acid 10% by Weight	Medium Density Polyethylene

Note:

1.

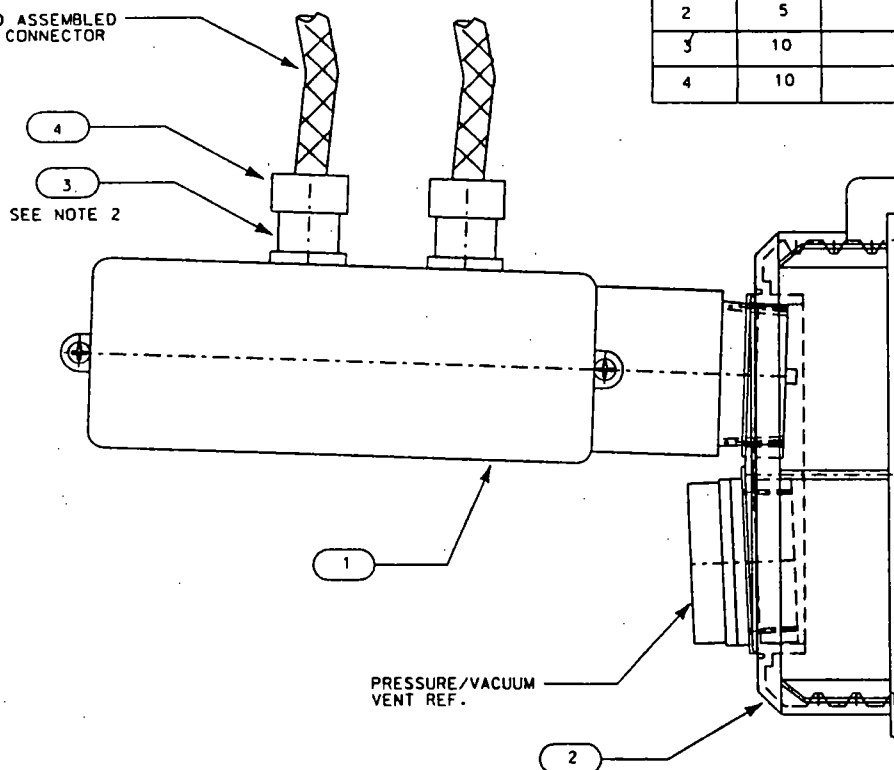
A 4ma signal indicates a low liquid level and a 20ma signal indicates that the storage container is at high level as measured from the face of the ultrasonic sensor.



FOR PURPOSES OF CLARITY
SENSOR NOT SHOWN IN THIS
VIEW

ATTACHMENT B

PORTABLE CORD ASSEMBLED
TO MULTI-PIN CONNECTOR



PRESSURE/VACUUM
VENT REF.

NOTE:

1. USE TEFLON TAPE FOR THE 2" PIPE THREADS. DO NOT PERMIT EXCESS TAPE TO EXTEND INTO PATH OF ULTRASONIC SENSOR.
2. MULTI-PIN RECEPTACLE TO BE ASSEMBLED TO SENSOR ENCLOSURE AT CONDUIT ENTRY HOLE LOCATIONS.

PARTS LIST			
ITEM	QTY	CIBA REF. SPEC.	DESCRIPTION
1	5		SENIX CORPORATION ULTRASONIC LEVEL SENSOR. MODEL ULTRA-5
2	5		CLAWSON STANDARD 7" POLY SCREW CAP WITH TWO 2" NPTS THREADED PORTS AND ONE 2" BLUE PV VENT
3	10		LIQUID TIGHT MULTI-PIN RECEPTACLE
4	10		LIQUID TIGHT MULTI-PIN CONNECTOR WITH PORTABLE CORD

NO.	REVISION	BY	DATE	APP
THIS IS A CAD GENERATED DRAWING. ALL REVISIONS MUST BE MADE ON CAD				
DESIGN DISCIPLINE	AUTOMATION			
CIBA-GEIGY		TOMS RIVER N.J.		
CORPORATE ENGINEERING				
DRAWN BY	PETROSKI	DATE	12/15/94	SCALE 1/2" = 1"
CHECKED BY		DATE		SIGNATURE
APPROVED BY		DATE		SIGNATURE
CRANSTON, RI - STABILIZATION ACTION INSTALLATION DETAILS. ULTRASONIC LEVEL TRANSMITTER				
DOC. No.	REFERENCES			
THIS DRAWING AND THE INFORMATION CONTAINED THEREIN IS THE EXCLUSIVE PROPERTY OF CIBA-GEIGY CORPORATION AND IS NOT TO BE REPRODUCED OR USED BY OTHERS WITHOUT WRITTEN PERMISSION				
ENG. No.	B-52075			REV. No.

SECTION
13431

DIFFERENTIAL PRESSURE TRANSMITTER

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide field mounted elements of electronic differential pressure transmitter and auxiliary equipment as described herein.

1.02 REFERENCES

- A. The codes and standards generally applicable to the work of this section are listed herein.

ANSI/NEMA - 1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment
(1000 volts maximum)

1.03 SUBMITTALS

- A. Provide submittals according to the requirements of Section 01300 except as specifically modified in this article. All submittals shall be shipped under separate cover to the owner.

1. Operation and maintenance manual (one per unit).
2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
3. Certificates of compliance.
4. Certified test reports.
5. Replacement parts and accessories listing, if not listed in Operation and Maintenance Manual.
6. Name, address, and telephone number of the nearest repair facility and/or information for obtaining on-site repair service.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Maintainability:

1. Designed for ease of maintenance and access to critical parts shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.
3. Manufacturer or distributor shall be capable of repair or provide replacement maintenance within 24 hours or less response time.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.02 EQUIPMENT

A. General:

1. Tag No.: PDIT-700
2. Function: Convert differential air pressure measurement, in linear proportion, to a 4 to 20 mA dc output signal capable of transmission into at least a 600 ohm load at 24V dc. No local indication
3. Power Supply: 24 Volts DC
4. Ambient Temp. Limits: Minus 20 to plus 185 degrees F
5. Humidity Limits: 0-100 percent relative humidity

B. Transmitter:

1. Output: Differential Type
4-20 mA; Signal and power transmission provided on a single pair of wires; Digital process variable superimposed on 4-20 mA signal available, to any host that conforms to the HART protocol, for interrogation and diagnostics without interruption of the transmitter's output signal
2. Local Indication: None
3. Range: TBD
4. Minimum Span: TBD
5. Overpressure Limit: 0 psia to 2,000 psig on either side without damage to the transmitter
6. Reference Accuracy: $\pm 0.1\%$ of span for spans from 1:1 to 6:1 of Upper Range Limit. Between 6:1 and 10:1 of Upper Range Limit, accuracy = $\pm 0.15\%$ of span or better.
7. Stability: $\pm 0.1\%$ of Upper Range Limit for six months
8. Ambient Temp. Effect: At maximum span, zero error not to exceed $\pm 0.025\%$ of span per 100 def F. The total effect including span and zero errors not to exceed $\pm 0.5\%$.
9. Damping: Analog output response user-selectable from 0 to 30 seconds minimum.
10. Failure Mode Alarm: High (>20 mA) output

- 11. Configuration
Memory: Non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption
- 12. Fill Fluid: Silicone
- 13. Housing: NEMA 4
- 14. Enclosure Class: None-Hazardous

C. Construction:
All wetted parts to be 316 SST

- 1. Process
Connection: 1/2-inch NPT 316L SST
- 2. Element Mat'l
and Type: 316 SST Diaphragm

D. Process:
1. Process Fluid: Air

E. Accessories:
1. Provide mounting bracket for mounting to 2 inch pipe.
2. Provide transmitter with 316 SST drain/vent valves.

2.02 Acceptable Manufacturers:

- A. Fisher & Porter
- B. Rosemount

PART 3 EXECUTION

3.01 EQUIPMENT TESTING AND CALIBRATION

- A. Factory Tests and Calibration:
 - 1. Factory-test pressure transmitter elements by the manufacturer to assure satisfactory performance prior to shipment. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

END OF SECTION

SECTION
13432

CHARACTERIZED BALL FLOW CONTROL VALVE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide field mounted elements of a "Characterized Ball" flow control valve as described herein.

1.02 RELATED SECTION

A. Section 13436

Limitorque Quarter Turn
Electric Actuator
Positioner

1.03 REFERENCES

- A. The codes and standards generally applicable to the work of this section are listed herein.
- ANSI - ANSI 16.5-81 Pipe Flanges and Flanged Fittings
AISI - American Iron and Steel Institute

1.04 SUBMITTALS

- A. Provide submittals according to the requirements of Section 01300 except as specifically modified in this article. All submittals to be shipped under a separate cover to the owner.
1. Operation and maintenance manual (one per valve minimum).
 2. Certified drawings showing outline dimensions, mounting options, and mounting accessories, if not included in Operation and Maintenance manual.
 3. Certificates of compliance.
 4. Certified test reports.
 5. Replacement parts and accessories listing, if not listed in Operation and Maintenance Manual.
 6. Name, address, and telephone number of the nearest repair facility

7. Valve sizing data as follows:
 - a. Control valve sizing sheet for flow conditions presented in this specification.
 - b. Plots of the Installed Flow Characteristics, Installed Gain, and Noise Level of the flow conditions specified.
 - c. Manufacturer shall supply calculations demonstrating that valves are not in cavitation state for the specified application.
8. Any characteristic, material, or specification listed as "Manufacturer's Standard" will be listed by vendor at time of quotation.

1.05 QUALITY ASSURANCE

- A. Manufacturer:
 1. A firm regularly and currently engaged in design and manufacture of similar equipment.
 2. Equipment shall be new and of current design.
 3. The valve body shall have an attached stainless steel label showing the direction of fluid flow. The recommended flow direction shall be clearly and permanently labeled on the valve body.
- B. Maintainability:
 1. Designed for ease of maintenance
 2. Access to critical parts shall not require major disassembly.
 3. Internal field adjustments where permitted or required easily accessible upon removal of a panel or cover.
 4. Manufacturer or distributor shall provide replacement maintenance for each item within 24 hours or less response time.
- C. Materials and Installation:
 1. Comply with requirements of referenced electrical codes and standards.
 2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
 3. Capacities of equipment: not less than that indicated.

1.06 WARRANTY

- A. Provide manufacturer's standard warranties for each of the specified items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Valve Tag Number: See Table "A" (Attachment)
Manufacturer shall provide stainless steel tags securely attached to the valve.
2. Service: See Table "A"

B. Service Conditions:

1. Fluid: Ground Water

	<u>Units</u>	<u>Nominal Flow</u>	<u>Max Flow</u>
2. Flow Rate	GPM	*	*
3. Inlet Press	PSIA	*	*
4. Outlet Press	PSIA	*	*
5. Diff Press	PSI	*	*
6. Inlet Temp	deg F	70	70
7. Specific Gravity		1.000	1.000
8. Viscosity	Centi-poise	0.974	0.974
9. Vapor Press	PSIA	0.363	0.363
10. Req'd Cv		*	*
11. Travel %		*	*
12. Predicted SPL	dBA	TBD	TBD

*Note: See Table "A"

C. Line:

1. Pipe Line Size In: See Table "A" (Provided for information purposes only)
2. Pipe Line Size Out: See Table "A" (Provided for information purposes only)
3. Pipe Line Insulation: None

- D. Valve Body/Bonnet:
1. Type: See Table "A"
 2. Size: See Table "A" ANSI Class: 150
 3. Max Press/Temp: See Table "A"/130 deg F ambient
 4. Body/Bonnet Matl: Manufacturer's standard
 - Bonnet: Manufacturer's standard
 5. Flange Face Finish: Standard ANSI Class 150 raised face flanges per ANSI B16.5
 6. End Extensions/Matl: None
 7. Flow Direction: Flow direction arrow to be permanently attached to valve body.
 8. Type of Bonnet: Manufacturer's standard
 9. Packing Material: Manufacturer's standard
 10. Packing Type: Manufacturer's standard
 11. Ambient Temperature : -40 F deg to +200 F deg

E. Trim:

1. Characteristic: Equal Percentage
2. Rated Cv: See Table "A"
3. Ball Material: Manufacturer's standard
4. Seat Material: Manufacturer's standard
5. Stem Material: Manufacturer's standard
6. Ambient Temperature: -40 F deg to +200 F deg

F. Tests

1. Hydrostatic Pressure: 165 psig per ANSI B16.37-80
2. Shutoff Classification: Standard Maximum allowable shutoff differential pressure forward or reverse flow @ 150 F deg shall be 200 psi.

2.02 Acceptable Manufacturers:

- A. Neles-Jamesbury
- B. Worcester

END of SECTION

(Attachment - Table "A", 1 page)

TABLE "A"
Ground Water Extraction System
Extracted Ground Water Flow Control

Tag No.	Service	Valve Body Type	Valve Size	Inlet Outlet Line Size	Minimum Flow Maximum Flow gpm	Inlet Pressure psia	Outlet Pressure psia	Diff. Pressure psi	Calculated Cv	Calculated Travel %
FCV110	Well 110 Groundwater Extraction, Pump PW-110	Flange ANSI 150	1"	1 1/2"	10 20	133 108	45 63	88 45	9.8 31.9	50.8 79.8
FCV 120	Well 120 Groundwater Extraction, Pump PW-120	Flange ANSI 150	3"	1.5"/3"	48 72	98 78	36 57	62 21	2.9 7.8	55.0 78.3
FCV310	Equalization Tank #1 Pre-Treated Groundwater, Pumps P-310 & P-311	Flange ANSI 150	2"	1.5"/3"	30 45	85 70	48 65	37 5	17.4 64.5	41.5 66.4
FCV330	Equalization Tank #2 Pre-Treated Groundwater, Pump P-330	Flange ANSI 150	2"	2"/4"	60 90	139 109	39 55	100 54	4.1 22.0	36.3 69.8
LCV610	Lift Station #1 Pre-Treated Groundwater, Pumps P-613 & P-614	Flange ANSI 150	3"	1.5"/3"	52 78	88 72	29 48	59 24	20.6 70.6	43.9 68.9
LCV715	Lift Station #2 Pre-Treated Groundwater, Pumps P-717 & P-718	Flange ANSI 150	1"	1 1/2"	11 17	87 65	28 44	59 21	37.2 79.0	54.3 71.7

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Characterized Ball
 Flow Control Valve
 13432 - A1

SECTION
13435

BUTTERFLY FLOW VALVE, PNEUMATIC ACTUATED

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Provide field mounted elements of a "Butterfly" flow valve system as described herein.

1.02 REFERENCES

- A. The codes and standards generally applicable to the work of this section are listed herein.
 - ANSI - ANSI 16.5-81 Pipe Flanges and Flanged Fittings
 - AISI - American Iron and Steel Institute

1.03 SUBMITTALS

- A. Provide submittals according to the requirements of Section 01300 except as specifically modified in this article. All submittals to be shipped under separate cover to the owner.
 - 1. Operation and maintenance manual (one per valve minimum).
 - 2. Certified drawings showing outline dimensions, mounting options, and mounting accessories, if not included in Operation and Maintenance manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Replacement parts and accessories listing, if not listed in Operation and Maintenance Manual.
 - 6. Name, address, and telephone number of the nearest repair facility
 - 7. Any characteristic, material, or specification listed as "Manufacturer's Standard" will be listed by vendor at time of quotation.

1.04 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. A firm regularly and currently engaged in design and manufacture of similar equipment.
 - 2. Equipment shall be new and of current design.
- B. Maintainability:
 - 1. Designed for ease of maintenance.

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Butterfly Flow Valve
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2. Access to critical parts shall not require major disassembly.
3. Internal field adjustments where permitted or required; easily accessible upon removal of a panel or cover.
4. Manufacturer or distributor shall provide replacement maintenance for each item within 24 hours or less response time.

C. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment: not less than that indicated.

1.05 WARRANTY

- A. Provide manufacturer's standard warranties for each of the specified items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Valve Tag No: See Table "A" (Attachment)

Manufacturer shall provide stainless steel tags securely attached to the valve.

2. Service: See Table "A"

B. Service Conditions:

1. Fluid: Groundwater

	<u>Units</u>	<u>Back Wash Flow</u>	<u>Max Flow</u>	<u>Norm Flow</u>
2. Flow Rate	GPM	*	*	*
3. Inlet Press	PSIA	*	*	*
4. Diff Press	PSI	*	*	*
5. Inlet Temp	deg F	70	70	70
6. Specific Gravity		1.000	1.000	1.000

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Butterfly Flow Valve
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7. Viscosity	Centi-			
	poise	0.974	0.974	.974
8. Vapor				
Press	PSIA	0.363	0.363	0.363
9. Req'd Cv		*	*	*
10. Travel	%	100	100	100

*Note: See Table "A"

C. Line:

1. Pipe Line Size In: See Table "A"
Out: See Table "A"
3. Pipe Line Insulation: None

D. Valve Body:

1. Type: See Table "A"
2. Size: See Table "A" ANSI Class: 150
3. Max Press/Temp: See Table "A"
4. Body Material: Ductile iron with corrosion resistant protective epoxy coating.
5. Liner Material: PTFE or equivalent
6. Flange Spacers: Flange spacers shall not be required for installation. Only flange sealing gaskets as required are permitted.
7. Flange Face Finish: To accommodate a lined valve body
8. End Extensions
Matl: None
9. Flow Direction: The valve body shall be capable of taking fluid flow in either direction.
10. Type of Bonnet: Standard
11. Packing Material: PTFE or equivalent consistent with the valve process application.
12. Packing Type: PTFE or equivalent consistent with the valve process application.
13. Ambient Temperature: +35 F deg to +200 F deg

E. Trim:

1. Characteristic: Equal Percentage
2. Rated Cv: See Table "A"
3. Disk Material: PTFE or equivalent encapsulated over ductile iron insert.
4. Seat Material: Seat material and design compatible with a lined valve body and encapsulated disk.
5. Stem Material: Stainless steel

6. Ambient Temperature: +35 F deg to +200 F deg

F. Actuator:

1. Type: Rack and Pinion Double Acting Pneumatic actuator with 4-way double solenoid valve.
2. Size: The sizing torque shall be based on the maximum torque encountered, during the stroke of the valve, when operating under a maximum working pressure of 150 psig and shutoff pressure of 150 psig.
3. On/Off: Actuator is for On/Off operation of a valve.
4. Utility Failure Mode: In the event of an air or electric failure, the valve shall remain in the last position.
5. Min Required Press.: 60 psig to fully stroke the installed valve.
6. Actuator Orientation: Actuator shall be aligned along valve flow axis.
7. Handwheel Type: Manual declutchable override handwheel shall be oriented perpendicular to the valve flow axis.
8. End-of-Travel Stops: Yes
9. Position Indicator: Yes

G. Switches:

1. Type: One solid state or magnetically actuated SPST NEMA 4 at each end of travel.
2. Contacts/Rating: 24 VDC @ 50 ma or 120 VAC @ 500 ma
3. Actuation Points: Fully open/Fully closed

H. Air Set:

1. Set Pressure: 80 psig
2. Filter: Yes Lubricator: Yes Gauge: Yes

I. Tests:

1. Hydrostatic Pressure: 165 psig per ANSI B16.37-80
2. Shutoff Classification: Maximum leakage is 1/100 of Class IV ANSI/FCI 70-2-76.

Maximum allowable shutoff differential pressure forward or reverse flow @ 150 F deg shall be 200 psi.

2.02 Acceptable Manufacturers:

- A. Durco
- B. Garlock

END OF SECTION

(Attachment - Table "A", 1 page)

TABLE "A"
Granulated Activated Carbon (GAC) Adsorption System
Treated Ground Water Flow Control

Tag No.	Service	Valve Body Type	Valve Size	Backwash Flow gpm	Max. Flow gpm	Min. Flow gpm	Maximum Inlet Pressure psia	Diff. Pressure psi	In/Out Line Size	Max Press/Temp psia/F	Required Cv	% Travel
FV 800A	Block Valve From Lift Station #2 to PH Adjustment Tank	Lug	4"	560	180	90	27.3	.25	4"	85/130	Max @ 100% open	On/Off 0-100
FV 800B	Influent Valve From Lift Station #2 to GAC	Lug	4"	560	180	90	27.3	.25	4"	85/130	Max @ 100% open	On/Off 0-100
FV 800C	Backwash Block Valve from GAC to Equalization Tank	Lug	4"	560	180	90	27.3	.25	4"	85/130	Max @ 100% open	On/Off 0-100
FV 800D	Effluent Valve from GAC to Potable Water	Lug	4"	560	180	90	27.3	.25	4"	85/130	Max @ 100% open	On/Off 0-100
FV 800E	Backwash Block Valve from Lift Station #2 to GAC	Lug	4"	560	180	90	27.3	.25	4"	85/130	Max @ 100% open	On/Off 0-100

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Butterfly Flow Valve
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SECTION 13436

LIMITORQUE QUARTER TURN ELECTRIC VALVE ACTUATOR/POSITIONER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Limitorque Quarter Turn Electric Valve Actuator/Positioner with options and accessories.

1.02 RELATED SECTIONS

- A. Section 13432 - Characterized Ball Flow Control Valve.
- B. Section 13451 - Modicon Programmable Logic Controller.

1.03 REFERENCES

- A. The codes and standards generally applicable to this section are:
 - ANSI - American National Standards Institute
 - CCITT- Consultative Committee for International Telephone and Telegraph
 - IEC - International Electrotechnical Commission
 - NEMA - National Electrical Manufacturers Association

1.04 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components:
 - 1. Operation and Maintenance manual(s) (one set per actuator minimum) including but not limited to:
 - a. Data for each component specified showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement; adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options, and mounting accessories, if not in Operation and Maintenance manual.
 - 3. Warranties for each of the specified components.

4. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.
5. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.
6. Certified measurement of percentage valve movement in response to command signal inputs over 0% to 100% to 0%, valve fully open to valve fully closed (9 points as indicated below).

Command % Signal <u>Input</u>	Measured % Valve <u>Position</u>	Measured % Signal <u>Feedback</u>
0		
25		
50		
75		
100		
75		
50		
25		
0		

1.04 SYSTEM DESCRIPTION

A. Actuator Design Requirements:

1. Operating Unit:
The quarter turn electric valve actuator shall consist of a high torque reversible motor, self-locking reduction gearing, end of stroke limit switches, mechanical torque sensing switch, a declutchable handwheel device, and end of stroke adjustable mechanical stops, all as a self-contained unit.
2. Sizing:
Actuator shall be sized and selected against valve operating torque values and safety factors stated by the referenced valve manufacturer. The sizing shall be based on the maximum torque encountered during the stroke of the valve when operating under maximum working pressure of 200 psig and shutoff pressure of 200 psig.
3. Duty Rating:
For modulating service, actuator shall be rated for 50 percent of the maximum output torque ratings.
4. Output:
Actuator output shall be of a hollow bored design supplied with a bushing adapter suitable for removal and machining by the valve manufacturer, in order to insure proper

fit with the valve stem.

5. Enclosure:

Actuator enclosure shall be of cast aluminum construction, designed to meet NEMA 4 water tight requirements, with an epoxy finish and cadmium plated high strength steel hardware.

B. Positioner Design Requirements:

1. Control of the actuator shall be accomplished through a microprocessor based two wire position control system. The position control system shall consist of the field unit, located in the actuator, linked by a single shielded twisted pair to a Modicon Compact 984 Programmable Logic Controller (PLC) through an appropriate hardware communication interface. RS-485 signals shall be transmitted over the twisted pair, to and from the field unit, to communicate digital data generated by the the Modicon PLC acting as a master station. The protocol shall be Modbus operating at 9600 baud maximum but adjustable to a lower rate. The two wire network shall permit additional field units to be connected in a looped fashion.
2. All network connections shall be protected by high level surge protectors, including but not limited to, gas discharge tubes and surge suppression diodes. Surge suppression shall be in compliance with CCITT standards and IEC 801.5.
3. Enclosure:
Positioner enclosure shall be of cast aluminum construction, designed to meet NEMA 4 water tight requirements, with an epoxy finish and cadmium plated high strength steel hardware.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty on each component provided.

1.06 ENVIRONMENTAL

A. Operation:

1. Temperature: Minus 40 to plus 85 degrees Centigrade
2. Humidity: 0 to 95 percent non-condensing

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.

2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Limitorque Corporation
5114 Woodall Road
P.O. Box 11318
Lynchburg, Virginia 24506-1318

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 EQUIPMENT

A. Actuator Unit:

1. Model: LY Series Quarter Turn Electric Valve Actuator.
2. Actuator Tag No.: See Table "A" (Attachment A)
3. Tag No. Type and Mounting: Stainless steel, securely attached to the actuator.
4. Service: See Table "A"
5. Electric Motor: Reversible squirrel cage induction motor wired for 460 Volts, 3-phase, 60 Hz; class F winding insulation; permanently sealed type motor bearing.
6. Operating Time: 30 seconds per 90 degrees
7. Motor Brake: None
8. Reduction Gearing: Double reduction unit consisting of self-locking worm gear drives suitable for maintaining valve position in the event of electric power failure; hardened alloy steel worm; alloy bronze worm gear; all power gearing grease lubricated.
9. Limit Switches: End of travel limit switches for each direction of travel; auxiliary switches capable of being set to operate for any point of travel; all switches shall be single-pole-double-throw, snap action type, totally enclosed and rated for 120 Volts AC.

10. Torque Switch: Double acting mechanical torque sensing switch responsive to loads encountered in either the opening or closing directions; switch shall be adjustable and have a calibration dial for each side of the switch; capable of operating during complete valve cycle without use of auxiliary relays, linkages, latches, or other devices; wired to shut off actuator motor in the event excessive loads are encountered during travel.
 11. Mechanical Stops: Adjustable end of stroke mechanical stops.
 12. Handwheel: Handwheel provided for manual operation; handwheel shall not rotate during motor operation; a seized motor shall not prevent manual operation of handwheel; when in manual operating position, actuator shall remain in this position until motor is energized at which time the actuator shall automatically return to electric operation and shall remain in motor operation until handwheel operation is desired; changeover to handwheel operation shall be accomplished by a positive declutching lever which disengages motor and motor gearing mechanically but not electrically; no loss of positional relationship between actuator and positioner, during handwheel operation.
 13. Valve Position Indicator: Visual indication to show direction and position of valve movement through 90 degrees of rotation.
 14. Actuator Orientation : See Figure 1 (Attachment B).
 15. Heater and Thermostat: Standard 120 Volts AC, 20 Watt space heater for actuator compartment.
 16. Enclosure Class: Non-Hazardous
 17. Safety Lockout: Three phase disconnect switch capable of being locked in the off position mounted integral with actuator enclosure.
 18. Safety Labels : Safety warning labels shall be secured to actuator housing sides so as to be visible from any direction.
- B. Positioner Unit:
1. Model: UEC-DDC (Universal Electronic Controller - Distributed Digital Controller) with analog board and DDC-100M Two Wire Control.
 2. Input/Output Signal: Digital commands over an RS-485 2-wire serial communication link using a subset of the Modbus protocol.
 3. Communication Link Capabilities:
 - a. Commands: Open Valve
Close Valve
Stop Valve
Lockout - Inhibit local and remote electrical operation

- b. Status:
 - Valve open and opening
 - Valve closed and closing
 - Valve stopped
 - Valve jammed
 - Selector switch in local
 - Valve moved by handwheel
 - c. Alarms:
 - Field unit failure
 - Motor overloads tripped
 - Torque switches tripped
 - Communication channel failure
 - Fail to energize or de-energize motor
 - 4. Input/Output Capabilities:
 - a. Digital Inputs: 9 (standard)
 - b. Digital Outputs: 3 (standard)
 - c. Analog Inputs: None required
 - d. Analog Outputs: None required
 - 5. Accessories
 - a. Local Control:

Actuator mounted LOCAL-REMOTE selector switch, valve OPEN pushbutton and indicator light, valve CLOSE pushbutton and indicator light, and valve STOP pushbutton wired directly to the positioner microprocessor. Malfunction or removal of serial communication link shall not affect local electrical operation.
 - b. Position Potentiometer:

Potentiometer feedback providing continuous indication of valve position.
 - c. Heater and Thermostat:

Standard 120 Volts AC, 20 Watt space heater for positioner compartment.
 - 6. Positioning Accuracy:

With actuator and valve fully assembled, position accuracy not to exceed plus or minus 1.5 percent of 90 degrees rotation.

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of all equipment listed to the specifications contained in the Limitorque product bulletins No. 150-10000 LY SERIES QUARTER TURN VALVE ACTUATORS Issue 4-92 or later revision, No. 450-10000 THE UEC-3 FROM LIMITORQUE, THE UNIVERSAL ELECTRONIC CONTROLLER Issue 2/94 or later revision, and No. 435-16000 TWO WIRE CONTROL SYSTEMS Issue 10-92 or later revision.

PART 3 EXECUTION

A. INSTALLATION

1. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

Attachment A - Table "A", 1 page
Attachment B - Figure 1, 1 page

TABLE "A"

Granulated Activated Carbon (GAC) Adsorption System
Limiterque Quarter Turn Electric Actuator

Tag No	Service
ZY 110	Flow Control Valve Actuator Well 110
ZY 120	Flow Control Valve Actuator Well 120
ZY 310	Flow Control Valve Actuator Equalization Tank #1
ZY 330	Flow Control Valve Actuator Equalization Tank #2
ZY 610	Flow Control Valve Actuator Lift Station #1
ZY 715	Flow Control Valve Actuator Lift Station #2

ACTUATOR ORIENTATION

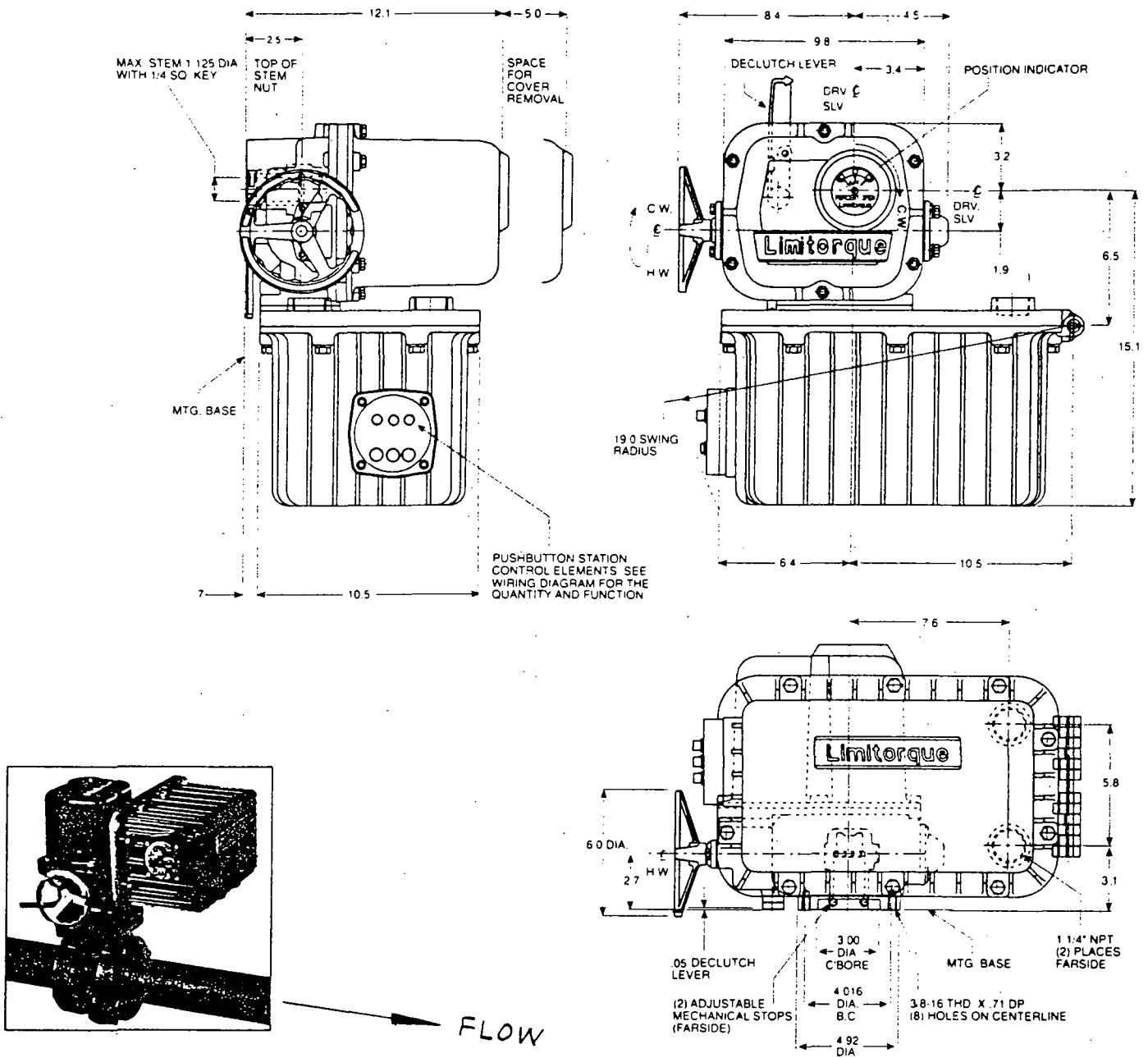


FIGURE 1

SECTION 13437

FLOW METER - MAGNETIC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of microprocessor based magnetic fluid flow metering element, transmitter, and auxiliary equipment options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)
- B. ANSI 16.5-81 Pipe Flanges and Flanged Fittings

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per flowmeter) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.
 - 6. Name, address, and telephone number of the nearest repair facility and

information for obtaining on-site service.

7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The magnetic flow meter shall consist of a in-line flowtube metering element with an integral electronic transmitter and shall be capable of measuring gallons per minute.

B. Flowtube Metering Element:

1. The flowtube metering element design shall use the principle of electromagnetic induction to produce a dc voltage proportional to the rate of liquid flow. Coils embedded in the flowtube shall generate a magnetic field to induce a voltage in the flowing liquid, which shall be sensed by a pair of electrodes in contact with the liquid. Coil excitation shall be pulsed dc.

C. Electronic Transmitter:

1. The electronic transmitter shall convert the process pressure measurement, in linear proportion, to a 4 to 20 milliamps DC output signal capable of transmission into at least a 600 ohm load.
2. Transmitter functions shall be controlled by a microprocessor. Transmitter shall include a non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption.
3. Transmitter shall be capable of superimposing a digital communication signal utilizing the Highway Addressable Remote Transducer (HART) protocol on the 4-20 milliamps DC signal for interrogation, configuration, and diagnostics with a HART host communicator device without interruption of the transmitter's output signal. As a minimum, the transmitter shall be capable of implementing the Universal and Common-Practice Commands as defined in the HART protocol.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No.: See TABLE "A" (Attachment)
2. Tag Label: Stainless Steel tags securely attached to the valve
3. Service: See TABLE "A"
4. Power Supply: 120 Volts AC plus or minus 10 percent, 60 Hz, single-phase
5. Ambient Temp.
Limits: Minus 40 to plus 150 degrees Fahrenheit
6. Humidity Limits: 10-100 percent relative humidity

B. Flowtube Metering Element:

1. Connections:
 - a. Line Size: See TABLE "A"
 - b. Line Material: See TABLE "A"
 - c. Connection Type: See TABLE "A"
 - d. Connection
Materials: See TABLE "A"
2. Construction:
 - a. Tube Material: 304 Stainless Steel with epoxy finish
 - b. Liner Material: Tefzel, PFA or equivalent
 - c. Electrode Type: Flush
 - d. Electrode Material: 316 Stainless Steel
 - e. Housing: NEMA 4
 - f. Enclosure Class: Non-Hazardous
 - g. Grounding: See TABLE "A"
3. Fluid:
 - a. Type: Groundwater
 - b. Nominal Flow,
gallons per minute: See TABLE "A"
 - c. Maximum Flow,
gallons per minute: See TABLE "A"
 - d. Maximum Velocity,
feet per second: See TABLE "A"
 - e. Maximum Temp.: 100 degrees Fahrenheit
 - f. Minimum Temp.: 40 degrees Fahrenheit
 - g. Maximum Pressure: 150 psig
 - h. Minimum Pressure: 20 psig

- i. Minimum Fluid Conductivity: Greater than 50 microSiemens per centimeter
- j. Vacuum Possibility: No

C. Transmitter:

- 1. Output Analog: 4-20 milliamps
- 2. Output Digital: Digital process variable, configuration and diagnostic data superimposed on 4-20 milliamps output signal, available to any host communicator that conforms to the HART protocol, without interruption of the transmitter's output signal
- 3. Local Indication: Digital Liquid Crystal Display
- 4. Span: See TABLE "A"
- 5. Accuracy: Plus or minus 0.5 percent of flow rate or better from 1 to 30 feet per second
- 6. Stability: Plus or minus 0.1 percent of rate for 6 months
- 7. Repeatability: Plus or minus 0.1 percent of rate
- 8. Damping: Electronic damping user selectable from 0 to 10 seconds minimum
- 9. Failure Mode: High (>20 milliamps) output
- 10. Configuration Memory: Non-volatile EEPROM memory to retain configuration, characterization, and digital trim data in event of power interruption
- 11. Mounting: Integrally mounted to the metering element flowtube
- 12. Housing: NEMA 4
- 13. Enclosure Class: Non-Hazardous

2.02 SOURCE QUALITY CONTROL

A. Factory Tests and Calibration:

- 1. Manufacturer shall test and calibrate flowmeter elements to assure conformance to listed specifications prior to shipment. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

2.03 ACCEPTABLE MANUFACTURERS

- A. ABB Kent-Taylor
- B. Bailey/Fischer & Porter
- C. Krohne
- D. Rosemount

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.**

END OF SECTION

Attachment - TABLE "A", 1 page

TABLE "A"
Magnetic Flowmeters

Tag No.	Service	Meter Size inches	Line Size inches	Connection Type	Pipe/Line Connection Materials	Ground	Nominal Flow gpm	Maximum Flow gpm	Nominal/Maximum Velocity thru Flowmeter ft/sec	4mA to 20mA Span gpm
FIT-110	Pumping Well 110 Flow Rate	1-1/2	2	Flange, ANSI 150	Carbon Steel	Straps	50	75	9.1 13.6	0 to 100
FIT-120	Pumping Well 120 Flow Rate	1	2	Flange, ANSI 150	Carbon Steel	Straps	15	20	6.1 8.2	0 to 30
FIT-130	Pumping Well 130 Flow Rate	1	2	Flange, ANSI 150	Carbon Steel	Straps	10	15	4.1 6.1	0 to 20
FIT-140	Pumping Well 140 Flow Rate	1	2	Flange, ANSI 150	Carbon Steel	Straps	10	15	4.1 6.1	0 to 20
FIT-200	Equalization Tank, T-200 Flow Rate	2	4	Flange, ANSI 150	PVC	Straps and Rings	60	140	6.1 14.3	0 to 140
FIT-300	Backwash Tank, T-300 Flow Rate	1-1/2	2	Flange, ANSI 150	PVC	Straps and Rings	30	60	5.5 10.9	0 to 60
FIT-500	Final pH Adjustment Tank, T-500 Flow Rate	2	4	Flange, ANSI 150	PVC	Straps and Rings	60	140	6.1 14.3	0 to 140

SECTION 13439

GREAT LAKES INSTRUMENTS pH TRANSMITTER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of Great Lakes Instruments pH transmitter, analyzer and auxiliary equipment options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per device) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.
 - 6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.

7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The pH transmitter shall consist of a sensor with integral two-wire transmitter, and a remotely connected electronic analyzer/indicating unit. The system shall be capable of measuring and indicating pH over the full range 0-14.

B. Sensor:

1. The pH sensor design shall use the concept of the Differential Electrode Measurement Technique patented by Great Lakes Instruments. The sensor shall consist of a process electrode and a "standard electrode" to make the pH measurement differentially with respect to a solution ground electrode. Within the standard electrode chamber shall be a glass electrode immersed in a buffered pH 7 solution. This inner chamber completes the electrical circuit with the process solution through a double-junction salt bridge.
2. The pH sensor shall contain an integral two-wire transmitter to provide a non-isolated and uncalibrated 4-20 milliamps DC output proportional to pH.
3. The pH sensor electronics shall be completely encapsulated to eliminate problems caused by moisture and high humidity.
4. The pH sensor shall include a temperature sensor to automatically compensate pH measurements for process temperature variations.

C. Receiver/Analyzer:

1. The receiver/analyzer shall connect directly to the pH sensor to provide indication, ON-OFF control, and signal conditioning such as range expand and output isolation. It shall contain an internal 24 Volts DC power source to drive the pH sensor two-wire transmitter and shall produce an isolated 4-20 milliamps DC output signal proportional to measured pH, capable of transmission into at least a 500 ohm load.
2. Receiver/analyzer shall have a 3½ digit liquid crystal display for direct pH indication and a 20-segment simulated analog bargraph for relative indication.

3. Receiver/analyzer shall have two single-pole-double-throw relays capable of being activated on increasing or decreasing pH reading, switch selectable by the user.
4. Receiver/analyzer shall be capable of being mounted on a surface using standard brackets supplied by the manufacturer.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty for each specified item.

1.06 QUALITY ASSURANCE

- A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

- B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

- A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

- B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be

in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Great Lakes Instruments, Inc.
8855 North 55th Street
Milwaukee, Wisconsin 53223

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 EQUIPMENT

A. General:

1. Tag Nos.: AE-500
2. Tag Label: Stainless Steel tags securely attached to the receiver/analyzer
3. Service: AE-500: pH in Final Adjustment Tank T-500
4. Ambient Temp. Limits: Minus 22 to plus 122 degrees Farenheit
5. Humidity Limits: 10-100 percent relative humidity, non-condensing

B. pH Sensor:

1. Model: 64-2-8-PO
2. Wetted Parts Material: Liquid crystal polymer thermoplastic body; liquid crystal polymer and PVDF (or ceramic) salt bridge; glass process electrode; titanium ground electrode; RTV sealant
3. Sensor element Style: Convertible style for submersion mounting
4. Sensor Type: Great Lakes Differential Electrode Measurment Technique with integral two-wire transmitter
5. Minimum Tank Depth: AE-500 = 8.0 feet
6. Process Fluid: Groundwater, 20% Sodium Hydroxide, 10% By Weight Sulfuric Acid
7. Power Supply: 24 Volts DC

- 8. Analog Output: 4-20 milliamps, non-isolated
- 9. Output Span: 0.95 milliamps per pH unit
- 10. Output Offset: 12 milliamps occurs at 7.0 pH ± 0.88 pH
- 11. Stability: 0.03 pH units per 24 hours non-cumulative
- 12. Sensitivity: Less than 0.005 pH unit
- 13. Sensor Cable: 2 conductor twisted pair, 10-foot length
- 14. Accessories:
 - a. Interconnect
 - Cable: 50-foot 2-wire plus shield, Part No. 99X1W0980
 - b. Protector: Part No. 60A2F1278
 - c. Union
 - Adapter: Part No. 60M2G9753-101
 - d. Mounting
 - Hardware: 1-inch x 4-foot CPVC Pipe and Coupling with PVC Pipe-Mount Junction Box, Part No. MH434B

C. Analyzer:

- 1. Model: Model 670-P3-F-115 Versalyzer
- 2. Analog Input: One 4-20 milliamps DC signal; instrument provides power to drive a two-wire transmitter (maximum load 100 ohms)
- 3. Analog Output: Isolated 4-20 milliamps, 500 ohms maximum load
- 4. Local Indication: 3½ digit liquid crystal display for direct reading; 20 segment bargraph for simulated analog display
- 5. Span: 0.00 - 14.00 pH
- 6. Sensitivity: 0.1 percent of Span
- 7. Stability: 0.1 percent of Span per 24 hours, non-cumulative
- 8. Repeatability: 0.05 milliamps
- 9. Non-Linearity: 0.1 percent of Span
- 10. Temperature Drift: Offset: 0.015 percent of Span per degree Centigrade
Span: 0.01 percent of Span per degree Centigrade
- 11. Mounting
 - Configuration: Surface
- 12. Enclosure Class: NEMA 4X
- 13. Power Supply: 115 Volts AC ± 15 percent, 60 Hz
- 14. Relay Function:
 - a. Control
 - Setpoints: Continuously adjustable, 0-100 percent of full scale
 - b. Control
 - Deadbands: Continuously adjustable, 0-50 percent of full scale
 - c. Indicators: Relay A or B annunciators flash on and off whenever instrument's control state turns on respective relay

- d. Relay Contact
Rating: Single-Pole-Double-Throw, 5 Amps 115/250 Volts AC; 5
Amps 30 Volts DC resistive

15. Accessories:

- a. Plug-in Output
Isolator
Board: Part No. 42B4A1001

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of all equipment listed to the specifications contained in the Great Lakes Data Sheet LCP - ENCAPSULATED pH/ORP SENSORS, No. LCP/1089 or later revision and Great Lakes Data Sheet MODEL 670 VERSALYZER, No. 670/388 or later revision.
- B. Factory Tests and Calibration:
Manufacturer shall test pH sensor elements and analyzers to assure satisfactory performance prior to shipment. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) with an uncertainty not more than 1/2 of specified or claimed accuracy of instruments.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

SECTION 13442

MULTI-POINT LEVEL SWITCH

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field mounted elements of an electronic multi-point level switch based on the Radio Frequency (RF)/impedance measurement technique and auxiliary equipment, options and accessories.

1.02 REFERENCES

- A. ANSI/NEMA 250-1985 Rev. 2 (5/88) - Enclosures for Electrical Equipment (1000 volts maximum)

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance manual (one per level switch) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.
 - 5. Warranties for each component.
 - 6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.

7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The multi-point level detection switch shall consist of a sensing probe with an integral electronic controller to detect the presence or absence of a liquid and provide separate switchable output contacts, which can be activated at each of four independent level set points anywhere along the sensing probe length.

B. Sensor:

1. The level sensor probe design shall use the concept of variable RF impedance when the probe is in contact with a liquid.

C. Electronic Controller:

1. The electronic controller shall convert the sensor variable RF impedance related to the process level measurement to an electronic signal and compare this signal to an adjustable level setpoint. Upon reaching the setpoint, the controller shall cause a change in an internal output relay logic state.
2. The controller shall contain, as a minimum, adjustments for coarse and fine sensitivity, dead band, and relay activation time delay.
3. The controller shall incorporate a self-diagnostic test, which can be initiated locally or by a remote computer, to check all functional stages of the controller including probe status, sensing electronics, and the output control relay.

1.05 WARRANTY

- ##### A. Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.
2. Equipment shall be new and of current design.

B. Materials and Installation:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. Designed for ease of maintenance and access to critical parts and shall not require major disassembly.
2. Internal field adjustments to be easily accessible upon removal of a panel or cover.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each component within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No: LSHL-600
2. Power Supply: 120 Volts AC plus or minus 10 percent, 50/60 Hz, single-phase
3. Operating Temp. Limits: Minus 40 to plus 140 degrees Farenheit
4. Humidity Limits: 10-100 percent relative humidity

- B. Sensor Probe:
1. Material: 316 Stainless Steel
 2. Insertion length: 48 Inches
 3. Mounting
Connection: Manufacturer's Standard
 4. Orientation: Vertical Axis
- C. Controller:
1. Location: Mounted on probe
 2. Adjustable
Response Time: 0 to 20 seconds minimum
 3. Delay Mode: Delay in both directions (turn-on and turn-off)
 4. Failure Mode: Field adjustable to either high or low level
 5. Sensitivity: 0.2 picofarad minimum
 6. Stability:
 - a. Temperature: Plus or minus 0.003 picofarad per degree Fahrenheit
 - b. Line Voltage: Plus or minus 0.25 percent per 20 volts
 7. Output relays: Double pole double throw (2 quantity), Single pole double throw (2 quantity)
 - a. Contact rating: 120 Volts AC; 5 Amperes non-inductive, 3 Amperes inductive
 8. Enclosure: NEMA 4
 9. Conduit
Connection: 1-inch NPT
- D. Service Conditions:
1. Process Material: Well Water
 2. Maximum Process
Pressure: Atmospheric
 3. Agitation
Horsepower: 1/3 HP
 4. Vessel material: Concrete Sump

2.02 SOURCE QUALITY CONTROL

- A. Factory Tests and Calibration:
1. Manufacturer shall test and calibrate single point level switch elements to assure conformance to listed specifications prior to shipment.

2.03 ACCEPTABLE MANUFACTURERS

- A. Drexelbrook
- B. Fisher & Porter
- C. Great Lakes Instruments

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

SECTION 13450
CONTROL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pumping Well Control Panels.
- B. Treatment Process Control Panels.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Modicon 984-145 Programmable Logic Controller.
- B. Modicon Modbus Plus Bridge/Multiplexer.
- C. Arcom SHIM HART Interface Unit.
- D. Moore Industries DIN Power Supply.
- E. Eaton IDT PanelMate Video Control Panel.

1.03 RELATED SECTIONS

- A. Section 13451 - Modicon Programmable Logic Controller.
- B. Section 13452 - Modicon Modbus Plus Bridge/Multiplexer.
- C. Section 13455 - Moore Industries DIN Power Supply.
- D. Section 13456 - Arcom SHIM HART Interface Unit.
- E. Section 13457 - Eaton IDT PanelMate Video Control Panel.

1.04 REFERENCES

- A. NEMA ICS 6 - Enclosures for Industrial Control and Systems.
- B. NFPA 70 - National Electrical Code.
- C. NFPA 79 - Electrical Standard for Industrial Machinery.

1.05 DIN - Deutsche Industrial Norms - A German agency that sets engineering and dimensional standards.

1.06 SUBMITTALS

A. Provide the following as a minimum:

1. Manufacturer's data for each component specified.
2. Shop drawings to include:
 - a. Dimensional and structural.
 - b. Layout of components.
 - c. Schematic diagrams.
 - d. Interconnection diagrams.
 - e. Loop diagrams.
 - f. Programmable Logic Controller Input/Output list.
 - g. External power requirements.
 - h. Bill of material.
3. Operation and Maintenance Manual.

1.07 QUALITY ASSURANCE

A. Component Manufacturers:

1. Firms regularly and currently engaged in design and manufacture of similar components.
2. Components shall be new and of current design.

B. Materials and Construction:

1. Comply with requirements of referenced electrical codes and standards.
2. Codes and standards referred to shall be used for establishing minimum quality of the materials and components supplied and installed.

1.08 SYSTEM DESCRIPTION

A. Pumping Well Control Panels (CP-110,CP-120):

1. Each Pumping Well Control Panel shall contain the programmable logic controller (PLC) responsible for controlling well level, the HART interface unit, the Modbus Plus Network bridge/multiplexer, the instrument loop power supply, and an interior panel temperature sensor.

2. All PLC input/output points shall be connected through terminal blocks mounted in the panel. The Modbus Plus and Modbus network connections shall be made at the corresponding network device using appropriate cable and connectors. HART compatible device signal cables shall be brought from each device to the panel and terminated at designated terminal blocks. Interconnections shall be made internally, at these terminal blocks, to route each device to the proper channel of the HART interface unit.
3. The PanelMate video control panel shall be mounted on the Pumping Well Control Panel door and used as an operator interface for manual control of the pump motor, process data readout, and PLC diagnostics.
4. A Resistance Temperature Device (RTD) type temperature transmitter shall be mounted internally to the panel to continuously monitor panel temperature.

B. Treatment Process Control Panels (CP-1,CP-2,CP-3,CP-4,CP-5):

1. The description of each Treatment Process Control Panel is the same as the Pumping Well Control Panel with the exception that the PanelMate video control panel is not used.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Enclosure:

1. General:
 - a. Single door steel enclosure 42.00-inches high, 36.00-inches wide, and 12.00-inches deep.
2. Construction:
 - a. Rated NEMA 4.
 - b. Minimum 14 gauge steel for body and door. Steel free of pitting and surface blemishes.
 - c. All exterior seams continuously welded and ground smooth. Surfaces free of all corrosion, burrs, sharp edges, and mill scale.
 - d. Stiffeners installed where necessary to ensure rigidity and prevent resonant vibrations.
 - e. Pan type door construction. Door mounted with removable stainless steel hinge pins.
 - f. Oil resistant gasket installed completely around door.
 - g. Key lockable three point door latching system with rollers on latch rods.

- h. Panel mounting brackets for interior panel.
 - i. Zinc phosphatized for corrosion protection.
 - j. ANSI 61 gray polyester powder interior and exterior finish.
- 3. Accessories:
 - a. 12-gauge steel interior panel 39.00-inches high, 33.00-inches wide; white enamel finish.
 - b. Touch-up paint for enclosure finish; furnished in spray can.
- 4. Manufacturers:
 - a. Hoffman Engineering Co., A-3L42H3612LP or approved equal.

B. Wiring:

1. General:

- a. All electrical wiring shall be in accordance with the applicable requirements of NFPA 70 and NFPA 79.
- b. Wire size:
600-volt class, 16 AWG PVC insulated stranded copper, Type MTW except where larger wire is required for a single load.
- c. Wiring for signal circuits:
Twisted shielded pairs, 300-volt class, 20 AWG PVC insulated stranded copper, 100 percent shield coverage, separated at least 6-inches from power wiring.
- d. Wiring shall be color coded according to function. The following color code shall be used:
 - BLACK - Unswitched Line Voltage Control or Power Circuits (Hot).
 - WHITE - Line Voltage Circuits (Neutral).
 - RED - Switched AC Control Circuits.
 - BLUE - DC Control Circuits.
 - YELLOW - Interlock Control Circuits Supplied From an External Power Source.
 - GREEN - Equipment Grounding Conductor.
- e. Two conductor shielded cable shall be color coded BLACK (+) and CLEAR (-).
- f. Wiring shall be enclosed in plastic wireways with covers or neatly tied with plastic ties as appropriate. Low voltage signal wires and connections (24 volts or less) and high voltage wires and connections shall be separated to the greatest extent possible, preferably on opposite sides of the enclosure.
- g. Where wires are terminated on screw terminals, insulated crimped locking fork lugs shall be used. Lugs shall be of the appropriate size for the terminal screws.
- h. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered sectional

terminal blocks mounted on 35 millimeter DIN type rail.

- i. Wiring shall be labeled at each end with the wiring identification shown on schematics and electrical drawings. Wire labels shall be the nonmetallic adhesive label or sleeve type with machine printed identification.
- j. Ground continuity between the enclosure, sub-panels, and enclosure doors shall be provided. All grounds shall be tied to a central location and not "daisy-chained" together. Where the grounding conductor is attached to a painted surface, the paint shall be removed in the area of the connection. Star type washers shall be used on all bolted ground connections.

2. Manufacturers:

- a. Type MTW 16 AWG wire:
Anixter catalog standard or approved equal.
- b. Twisted-pair shielded 20 AWG cable:
Belden 8762 or approved equal.
- c. Insulated crimp type locking fork lugs:
Thomas & Betts nylon insulated STA-KON type or approved equal.
- d. Plastic wireways:
Panduit PANDUCT Type E PVC white snap-in slot duct with Type C non-slip cover or approved equal.
- e. Plastic wire ties:
Thomas & Betts nylon TY-RAP type or approved equal.

C. Circuit Breaker and Fuses:

1. General:

- a. Circuit Breaker:
Molded case, thermal-magnetic, single pole, toggle operation, DIN rail mounted, 120-volts AC; current rating as shown on the Drawings.
- b. Fuses:
Dual element time delay; 1/4-inch diameter, 1 1/4-inches long; current rating as shown on the Drawings.

2. Manufacturers:

- a. Circuit Breaker:
Entrelec Type GM or approved equal.
- b. Fuses:
Bussman Type MDL or approved equal.

D. Terminal Blocks:

1. General:

- a. Double-sided, sectional barrier type with tubular compression clamp, rated for 300-volts; appropriately sized for wire gauge terminated and

- current load.
 - b. White plastic identification numbers installed.
 - c. Mounted on symmetrical 35 millimeter DIN rails.
 - d. Where possible, special purpose terminal blocks such as fuse holders or three level high density blocks shall be used.
 - e. Provide 20 percent spare terminals.
 - 2. Manufacturer:
 - a. Terminal Blocks:
Entrelec Type M or approved equal.
 - b. Fuse Terminal Blocks:
Entrelec Type M 10/13T with blown fuse indicator or approved equal.
 - c. Three Level High Density Block:
Entrelec Type D 2,5/6.DA or approved equal.
- E. Labels and Nameplates:
 - 1. General:
 - a. Provide machine printed self-adhesive labels identifying all major panel components as shown on the Drawings.
 - b. Provide engraved plastic laminate identification nameplate mounted to the exterior of the control panel enclosure as shown on the Drawings.

2.04 SOURCE QUALITY CONTROL

- A. Hardware Test:
 - 1. Verify wiring connections and continuity as shown on the Drawings.
 - 2. Perform system test on each sub-system verifying correct operation of each peripheral.
- B. Software Test:
 - 1. Where feasible, verify software operation through emulation or simulation of analog and digital inputs.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install Control Panel as shown on Drawings, and according to applicable codes.

3.02 FIELD QUALITY CONTROL

- A. Verify field wiring connections and continuity as shown on the Drawings.
- B. Perform system test on each sub-system verifying correct operation of each peripheral.

END OF SECTION

SECTION 13451

MODICON PROGRAMMABLE LOGIC CONTROLLER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modicon 984 Compact Programmable Logic Controller (PLC) with input/output units, options and accessories.

1.02 RELATED SECTIONS

- A. Section 13452 - Modicon Modbus Plus Bridge/Multiplexer.

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components:
 1. Data for each component specified showing electrical characteristics and connection requirements.
 2. Bound copies of operating and programming instructions.
 3. Maintenance data including module replacement, adjustments, and preventive maintenance procedures and materials.
 4. Warranties for each of the specified components.
 5. Name, address, and telephone number of the nearest repair facility.
 6. List of replacement parts and accessories for each component.

1.04 SYSTEM DESCRIPTION

- A. Design Requirements:

The PLC shall be microprocessor based and programmed in written ladder logic. It shall be capable of performing both discrete and analog (minimum one Proportional-Integral-Derivative loop) control functions. It shall also be capable of network communication between itself and a host computer or other similar PLCs.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty on each component provided.

1.06 ENVIRONMENTAL

A. Operation:

1. Temperature: 0 to 60 degrees Centigrade
2. Humidity: 0 to 95 percent non-condensing

1.07 MAINTENANCE

A. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for each item within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. MODICON, Inc.
Industrial Automation Systems
One High Street
North Andover, MA 01845

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 EQUIPMENT

A. Processor Unit:

1. Model: 984-145
2. User Memory: 8-KByte
3. Storage Registers: 1920
4. Input/Output Capacity: 256, any mix
5. Scan Rate: 5 milliseconds per KByte
6. Programming Language: Ladder diagram; optional C language

- 7. Logic Operations: AND, OR, XOR, NOT
 - 8. Register Operations: Store, recall
 - 9. Arithmetic Operations: Addition, subtraction, multiplication, division, square root
 - 10. Enhanced Functions: Floating point math, trigonometric functions, Proportional-Integral-Derivative (PID) control, subroutines
 - 11. Other Functions: Timer, counter, stepping and shift register, data moving operations, and additional functions defined in the 984 base instruction set
 - 12. Non-volatile Program and Data Storage: Battery backup
 - 13. Networking Capability: Built-in Modbus and Modbus Plus interfaces
- B. Power Supply Module P120:
- 1. Input Voltage: 95 to 270 Volts AC, 47/63 Hz
 - 2. Output Voltage: 24 Volts DC at 1 Amp
- C. Analog Input Module BADU 206:
- 1. Description: Voltage/Current (2 pole)
 - 2. Number of Channels: 4
 - 3. Operating Range: $\pm 1/\pm 10/2-1/2-10$ Volts DC
 $\pm 20/4-20$ milliamps DC
 - 4. Isolation: Channel-Bus: 500 V, Channel-External Supply: 500 V Channel-Channel: None
 - 5. Input Impedance: 1M Ohm Voltage, 50K Ohm Current
 - 6. Resolution: 12 bit
 - 7. Accuracy: 0.5% of Full Scale
 - 8. Conversion Time: 10 milliseconds for all channels, maximum
 - 9. Internal Power Required: 20 milliamps @ 5 Volts DC
 - 10. External Power Required: 70 milliamps @ 24 Volts DC
- D. Discrete Input Module BDEP-218:
- 1. Description: 115 Volts AC Input
 - 2. Number of Points: 16
 - 3. Operating Range: 115 Volts AC, 47-63 Hz
 - 4. Isolation: Optocoupler
 - 5. Number of Groups: 2
 - 6. Points per Group: 8
 - 7. On Conditions: 80-132 Volts AC
 - 8. Off Conditions: 0-35 Volts AC
 - 9. On Current: 6 milliamps/input
 - 10. Off Current: 3 milliamps/input

11. Response Time
Off to On: 10 milliseconds
12. Response Time
On to Off: 40 milliseconds
13. Internal Power
Required: 60 milliamps @ 5 Volts DC
14. External Power
Required: None

E. Discrete Output Module BDAP-208:

1. Description: Relay (NO)
2. Number of Points: 8
3. Operating Voltage: 24-110 Volts DC, 24-250 Volts AC
4. Isolation: Relay Contact
5. Number of Groups: 8
6. Points per Group: 1
7. On Current per Point: 2 amperes maximum, continuous
8. Wetting Current: 5 milliamps
9. Leakage Current: 1 milliamp
10. Response Time
Off to On: 10 milliseconds
11. Response Time
On to Off: 10 milliseconds
12. Internal Power
Required: 60 milliamps @ 5 Volts DC
13. External Power
Required: 150 milliamps @ 24 Volts DC

F. Accessories:

1. DTA-200 Primary Backplane
2. DTA-201 Five-Slot Secondary Backplane
3. AS-MBKT-085 Line Connector for Modbus Plus Port

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of all equipment listed to the specifications contained in the Modicon publications 984-A120 COMPACT PROGRAMMABLE CONTROLLERS USER GUIDE, Modicon No. GM-A984-PCS Rev. A or later revision, and A120 SERIES I/O MODULES USER GUIDE, Modicon No. GM-A984-IOS Rev. B or later revision.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.**

END OF SECTION

SECTION 13452

MODICON MODBUS PLUS BRIDGE/MULTIPLEXER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modicon Modbus Plus Bridge/Multiplexer.

1.02 RELATED SECTIONS

- A. Section 13451 - Modicon Programmable Logic Controller.

1.03 SUBMITTALS

- A. Provide the following, as a minimum, with delivery:
 - 1. Data showing electrical characteristics and connection requirements.
 - 2. Bound copy of operating and programming instructions.
 - 3. Maintenance data including replacement items, adjustments, and preventive maintenance procedures and materials.
 - 4. Warranty terms and conditions.
 - 5. Name, address, and telephone number of the nearest repair facility.

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. The Modbus Plus Bridge/Multiplexer shall be microprocessor based and field configurable by resident, menu driven software using a personal computer running terminal emulation software. It shall be capable of connecting Modbus based devices to the Modbus Plus Network. Each of its Modbus ports shall be configurable as Master or Slave and capable of implementing any of the port parameters possible with conventional Modbus ports.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty.

1.06 ENVIRONMENTAL

A. Operation:

1. Temperature: 0 to 60 degrees Centigrade
2. Humidity: 0 to 95 percent non-condensing

1.07 MAINTENANCE

A. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. MODICON, Inc.
Industrial Automation Systems
One High Street
North Andover, MA 01845

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 EQUIPMENT

- A. Modicon Model NW-BM85-000 Modbus Plus Bridge/Mux.
- B. Modicon Modbus Plus Planning and Installation Guide No. GM-MBPL-001 or later edition.

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of the equipment to the specifications contained in Modicon product bulletin No. MC-BM85-000, Rev. A or later revision.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

SECTION 13455

MOORE INDUSTRIES DIN POWER SUPPLY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Moore Industries Model DPS DIN Power Supply.

1.02 RELATED SECTIONS

- A. Section 13450 - Control Panels.

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery:
 - 1. Data showing electrical characteristics and connection requirements.
 - 2. Bound copy of operating and programming instructions.
 - 3. Maintenance data including replacement items, adjustments, and preventive maintenance procedures and materials.
 - 4. Warranty terms and conditions.
 - 5. Name, address, and telephone number of the nearest repair facility.

1.04 DEFINITIONS

- A. DIN - Deutsche Industrial Norms - A German agency that sets engineering and dimensional standards.

1.05 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. The Power Supply shall provide 24 Volts DC output voltage at 1200 milliamps output current for use with loop powered transmitters. It shall be designed with continuous short circuit and short term (<15 seconds) overload protection. It shall also be designed with input/output isolation, convection cooling, and derated internal circuits for added dependability. The power supply shall be enclosed in a compact rail-mount DIN-style housing designed especially for industrial environments.

1.06 WARRANTY

- A. Provide manufacturer's standard warranty.

1.07 ENVIRONMENTAL

- A. Operation:
1. Temperature: 0 to 50 degrees Centigrade.
 2. Humidity: 5 to 95 percent

1.08 MAINTENANCE

- A. Maintenance Service:
1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Moore Industries
16650 Schoenborn Street
Sepulveda, California 91343

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 EQUIPMENT

- A. Moore Industries DPS DIN Power Supply:
1. Model: DPS/24DC/1200MA/117AC [DIN]
 2. Output Voltage: 24 Volts DC ± 10 percent, internally adjustable
 3. Output Current: 1200 milliamps maximum at 50 degrees Centigrade (175 milliamps minimum load)
 4. Input Supply Voltage: 117 Volts AC ± 10 percent
 5. Housing: Aluminum, DIN-style rail mount

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of the equipment to the specifications contained in Moore Industries Data Sheet No. 11.10 DPS DIN POWER SUPPLIES, June 1990 or later revision and Data Sheet No. 13.04 ALUMINUM DIN-STYLE HOUSING, July 1989 or later revision.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings

END OF SECTION

SECTION 13456

ARCOM SHIM-8 HART INTERFACE UNIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Arcom SHIM HART Interface Unit with options and accessories.

1.02 RELATED SECTIONS

- A. Section 13451 - Modicon Programmable Logic Controller.
- B. Section 13452 - Modicon Modbus Plus Bridge/Multiplexer.

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery:
 - 1. Data showing electrical characteristics and connection requirements.
 - 2. Bound copy of operating and programming instructions.
 - 3. Maintenance data including replacement items, adjustments, and preventive maintenance procedures and materials.
 - 4. Warranty terms and conditions.
 - 5. Name, address, and telephone number of the nearest repair facility.

1.04 DEFINITIONS

- A. HART - Highway Address Remote Transducer - A digital communication protocol designed by and licensed from Rosemount Inc.

1.05 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. The HART Interface Unit shall be capable of providing communication access from a Modbus master device to HART compatible digital devices. It shall have the capability to multiplex up to 8 HART communication channels connected point-to-point or up to 64 multidrop HART devices. It shall also be capable of implementing the HART burst mode on any

channel where the HART device is connected point-to-point.

1.06 WARRANTY

- A. Provide manufacturer's standard warranty.

1.07 ENVIRONMENTAL

- A. Operation:

1. Temperature: minus 20 to plus 70 degrees Centigrade
2. Humidity: 5 to 95 percent

1.08 MAINTENANCE

- A. Maintenance Service:

1. Manufacturer shall offer a means for replacement or repair maintenance service within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Arcom Control Systems, Inc.
13510 South Oak Street
Kansas City, Missouri 64145

2.02 EQUIPMENT

- A. Arcom Model SHIM-8, 8-channel HART Interface Unit.

2.03 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of the equipment to the specifications contained in the SHIM HART Interface Unit product bulletin, latest revision.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.**

END OF SECTION

SECTION 13457

EATON IDT PANELMATE VIDEO CONTROL PANEL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Eaton IDT PanelMate Series 1000 Video Control Panel with options.

1.02 RELATED SECTIONS

- A. Section 13451 - Modicon Programmable Logic Controller.

1.03 SUBMITTALS

- A. Provide the following, as a minimum, with delivery:
 - 1. Data showing electrical characteristics and connection requirements.
 - 2. Bound copy of operating and programming instructions.
 - 3. Maintenance data including replacement items, adjustments, and preventive maintenance procedures and materials.
 - 4. Warranty terms and conditions.
 - 5. Name, address, and telephone number of the nearest repair facility.

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. The Eaton IDT PanelMate Series 1000 Video Control Panel shall perform the function of operator interface to a Modicon Programmable Logic Controller (PLC). It shall be capable of replacing conventional hardwired pushbuttons, switches, equipment status indicators, numeric readouts, and message displays with a combination of video screens and sealed membrane control buttons which communicate directly with the PLC registers over the Modbus serial communications link. Video panel configuration shall be accomplished using a personal computer and DOS-based, off-line, fill-in-the-blanks configuration software.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty.

1.06 ENVIRONMENTAL

- A. Operation:

1. Temperature: 0 to 50 degrees Centigrade
2. Humidity: 20 to 85 percent non-condensing

1.07 MAINTENANCE

- A. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton IDT, Inc.
173 Heatherdown Drive
Westerville, Ohio 43081

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 EQUIPMENT

- A. Eaton IDT PanelMate Video Control Panel:
1. Model: Series 1000, Part No. 1208
 2. Display: 5-inch monochrome backlit flat LCD with blink; 320 X 240 pixels resolution
 3. Operator Entry: 3 X 2 cells TouchPanel matrix for control selection; 0 to 9, ., -, numeric entry keypad; Four membrane control buttons
 4. Audio Output: Built-in annunciator responds to control button actuation and alarm conditions (when desired)

5. External Connections: Serial port, selectable RS-422 or RS-232C, 110 to 19,200 baud
6. Protective Front Panel: NEMA 4 when properly mounted in a NEMA 4 enclosure; High contrast display filter; Polane enamel paint
7. Input Supply Voltage: 24 Volts DC nominal, (18-30 Volts DC acceptable)
8. Input Supply Current: 440 milliamps at 24 Volts DC
9. Equipment Heat Output: 11 watts (38 BTU/hr)

B. Options:

1. Modbus PLC Communication Driver: Part No. 1224
2. 115 Volts AC to 24 Volts DC Converter Module: Part No. 1216

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of the equipment to the specifications contained in Eaton IDT product bulletin No. MK-ML002-00, 1993 or later revision.

PART 3 EXECUTION

3.01 INSTALLATION

- A.. Installation shall be in accordance with the manufacturer's instructions and approved drawings.

END OF SECTION

SECTION 13460

CONTROL ROOM HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Desktop personal computer with color monitor, operating system software, printer, options and accessories.

1.02 RELATED SECTIONS

- A. Section 13470 - Wonderware InTouch Man-Machine Interface Software.

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components:
 - 1. Data for each component specified showing electrical characteristics and connection requirements.
 - 2. Bound copies of operating and programming instructions.
 - 3. Original plus one backup copy of operating system software on 3-1/2-inch high density floppy disk media.
 - 4. Maintenance data including module replacement, adjustments, and preventive maintenance procedures and materials.
 - 5. Warranties for each of the specified components.
 - 6. Name, address, and telephone number of the nearest repair facility.
 - 7. List of replacement parts and accessories for each component.

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. The desktop personal computer (PC) located in the Control Room shall be used as the primary operator interface to the Process Control and Monitoring System (PCMS) for the Final Stabilization Action at the Ciba-Geigy Facility, Cranston, Rhode Island. It shall be capable of running Microsoft DOS, Microsoft Windows 3.1 and the Wonderware InTouch

Man-Machine Interface software. It shall also be capable of communicating, through an appropriate interface board and driver software, to the Modicon Modbus Plus network for sending and retrieval of data from PCMS Modicon Programmable Logic Controllers.

2. The PC monitor shall be a color, low emissions type with a 15-inches measured diagonally viewing area and multi-sync refresh rate capability. The monitor shall be capable of supporting Video Graphics Array (VGA), SuperVGA, and 1024x768 (non-interlaced) lines resolution.
3. Connected to the PC parallel port shall be a 24-wire dot-matrix type printer capable of printing graphics and letter quality text on 8-1/2-inches by 11-inches fanfold or cut sheet paper. It shall also have the capability, using the appropriate ribbon, to perform seven color printing.
4. Also connected to the PC shall be a external combination fax and data modem. The modem shall support speeds up to 14,400 bits per second. The modem shall be used for remote dial-up and monitoring of the PCMS and to alert key personnel about PCMS alarm conditions through the fax dial-out feature.
5. The PC shall be protected against surges, spikes, brownouts, blackouts, and line noise by an uninterruptible power supply (UPS).

1.05 WARRANTY

- A. Provide manufacturer's standard warranty on each component provided.

1.06 MAINTENANCE

- A. Maintenance Service:

1. Manufacturer shall offer a renewable one year on-site maintenance agreement for each component.

- B. Software upgrade:

1. Manufacturer shall offer a renewable one year software upgrade service.

PART 2 PRODUCTS

2.01 DESKTOP PERSONAL COMPUTER

- A. Central Processing Unit (CPU):

1. The CPU shall be an Intel 486DX2 microprocessor with integral math coprocessor. Clock speed shall be 50 MHz. The unit shall support 32-bit memory addressing and a 32-bit data path. ROM based power-on and self diagnostics shall be provided to automatically boot-up the computer and check major system components.

B. System Board:

1. System Board shall contain six full-size connector slots for the installation of feature circuit boards. Four of these slots shall be for 16-bit, ISA circuit boards. Two of the slots shall be compatible with either VESA or ISA circuit boards.
2. Installed Random Access Memory (RAM) shall be 16 megabytes with the capability to expand to 64 megabytes. The memory access time shall be 70 nanoseconds or better.
3. Installed cache memory shall be 128 kilobytes.
4. System Board shall contain a disk controller capable of operating a minimum of three disk drives. The unit shall provide the necessary control for both the floppy and hard disk drives specified.
5. Integral to the System Board shall be a keyboard controller, interrupt controller, direct memory access (DMA) controller, mouse controller, and a battery powered real-time clock.
6. System Board shall have the capability to control two asynchronous serial communications input/output ports and one parallel printer port. The serial ports shall have 9-pin, D-shell, RS-232C connectors. The parallel port shall have a 25-pin, D-shell connector.

C. Video Adapter:

1. Video adapter shall be VESA-VL Local Bus compatible and be installed in one of the System Board VESA/ISA slots. It shall have one megabyte of Video RAM and be capable of displaying 256 colors out of a palette of 16.7 million. It shall produce a screen resolution of 640 horizontal by 480 vertical pixels or 1024 horizontal by 768 vertical pixels non-interlaced, selectable by software. The adapter shall be Video Graphics Array (VGA) and SuperVGA (SVGA) compatible. The adapter shall also provide text displays of 80 columns by 25 lines. The video output signal shall include RGB, horizontal and vertical sync, and intensity. Signal level shall be TTL and the port shall be a 15-pin, D-shell connector.

D. Hard Disk Drive:

1. The hard disk drive shall be an Integrated Device Electronics (IDE) type with an unformatted capacity of 340 megabytes. It shall have an average access time of 23 milliseconds or less and a data transfer rate of 5 megabits per second or better. The unit shall be controlled by the disk controller specified above.

E. Floppy Disk Drive:

1. The floppy disk drive shall provide 1.44 megabytes of formatted capacity and shall use 3.5-inch soft-sectored, double-sided, high density disks. The unit shall be controlled by the disk controller specified above.

F. Keyboard:

1. The keyboard shall be manufacturer's standard 101-key enhanced IBM AT-style.

G. Mouse:

1. The mouse shall be manufacturer's standard 2-button mouse.

H. Storage Bays:

1. The computer shall have a total of five storage bays: three 5.25-inch external, one 3.5-inch internal, and one 3.5-inch half-height external containing the 3.5-inch floppy disk drive specified above.

I. Internal Power Supply:

1. The computer shall be powered by 120 Volts AC, 60 Hz and have an internal power supply rated at 200 watts output.

J. Operating Systems Software:

1. The computer shall be preloaded by the manufacturer with the latest version of MS-DOS and Windows for Workgroups 3.11.

J. Manufacturer:

1. Digital Equipment Corporation Model DECpc LPx+.

2.02 MONITOR

A. General:

1. The monitor shall be a 15-inch flat square, low emissions multi-frequency color CRT. The unit shall have a .28 millimeter dot pitch and a screen resolution up to 1024 horizontal by 768 vertical pixels (SVGA) non-interlaced.
2. The monitor's video input signals shall be TTL type and include horizontal and vertical sync, red, green and blue color, and intensity. The monitor shall be compatible with screen refresh frequency rates of 60 to 75 Hz. The unit shall include a 15-pin (DB15) signal cable.
3. The monitor shall be powered by 120 Volts AC, 60 Hz and be designed to use a minimum amount of energy. It shall meet Swedish MPRII standards for low electro-magnetic and electro-static emissions.

B. Construction:

1. The monitor shall be housed in a desktop enclosure with tilt-swivel base and front-panel controls.

C. Manufacturer:

1. Digital Equipment Corporation Model FR-PCXBV-PC.

2.03 PRINTER

A. General:

1. Printer shall be a 24-wire dot-matrix impact type with full ASCII character set and compatibility with the Epson LQ and IBM Proprinter protocols as a minimum. It shall be capable of printing letter-quality text and graphics with a density of 360 dot per inch. Smallest character pitch shall be 16.67 characters per inch minimum. It shall have a built-in Centronics type parallel interface for connection to the standard parallel printer port on a personal computer.
2. Effective print speed shall be 300 characters per second in draft mode and 99 characters per second in letter quality mode minimum.
3. The printer shall be capable of 7-color printing with the appropriate ribbon installed and provide the driver interface to allow printing from Microsoft Windows 3.1.
4. Printer shall be capable of accepting tractor feed type fanfolded paper, cut sheets, and up to 5 multipart forms.

B. Manufacturer:

1. Digital Equipment Corporation Model DECwriter 95.

2.04 MODEM

A. General:

1. The modem shall be a desktop type and be capable of implementing the V.32bis/V.32 standards for data communications and the Group 3/EIA TR-29 Class 2 standards for fax transmissions. Speeds shall be 14,400 bits per second (V.32bis) and 9600 bits per second (V.32) for data communications and either 9600 or 4800 bits per second for fax transmissions. The modem shall also be downward compatible with modems at speeds as low as 300 bits per second. The modem shall also have the capability for V.42 error correction, V.42bis data compression in which the data communication speeds can approach 57,600 bits per second and data sent will be 100% error free and the Microcom Network Protocol (MNP) Level 5 data compression protocol.
2. The modem shall provide interactive automatic dialing capability, Command mode option configuration and be compatible with the "AT" command set. It shall be capable of storing in non-volatile memory up to ten command line/telephone numbers, of up to 60 digits each.
3. The modem shall be able to use pulse and/or tone dialing methods and have the ability to recognize dial tones and busy signals for reliable call-progress detection.
4. The shall be powered by 120 Volts AC, 60 Hz through an appropriate adapter provided by the manufacturer.
5. Fax modem software shall be provided by the manufacturer and be compatible with Microsoft Windows 3.1.

B. Manufacturer:

1. Multi-Tech Systems Model MT1432BA.

2.04 UNINTERRUPTIBLE POWER SUPPLY

A. General:

1. The Uninterruptible Power Supply (UPS) shall provide protection against power surges, spikes, brownouts, blackouts, and line noise. The UPS shall be capable of supplying a load of 600 Volt-Amps for a minimum of 5 minutes.

B. Manufacturer:

1. American Power Conversion Model APC 600VA.

2.05 MODICON MODBUS PLUS NETWORK ADAPTER

A. General:

1. The Modicon Modbus Plus Adapter shall interface the personal computer to the Modbus Plus programmable logic controller network to provide the ability to communicate control and process data between the PLC and the computer. The adapter shall be compatible with the ISA computer bus and be able to be mounted inside the personal computer. Adapter software shall be compatible with MS-DOS 6.0 or later revision.

B. Manufacturer:

1. Modicon SA85 Modbus Plus Network Adapter.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.**

END OF SECTION

SECTION 13470

WONDERWARE INTOUCH MAN-MACHINE INTERFACE SOFTWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wonderware InTouch Man-Machine Interface Software.

1.02 RELATED SECTIONS

- A. Section 13451 - Modicon Programmable Logic Controller.

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components:
 - 1. Two (2) sets of Operation, Maintenance and Software Reference manuals on each of the specified components.
 - 2. Warranties for each of the specified components.
 - 3. Name, address, and telephone number of the nearest support facility.
 - 4. Software license agreements and, if required, registration cards.

1.04 WARRANTY

- A. Provide software supplier's standard warranty on each component provided.

1.05 MAINTENANCE

- A. Maintenance Service:
 - 1. Software supplier or Distributor shall offer a means for immediate telephone software support during the hours of 8 A.M. to 5 P.M. Eastern Time Monday through Friday and on-site support for each component within 24 hours or less.
 - 2. Provide a renewable one year maintenance agreement for each component.
- B. Software Upgrade:

1. Provide a renewable one year software upgrade service.

1.06 SYSTEM DESCRIPTION

A. Performance Requirements:

1. General:

- a. The specifications that follow indicate the extent and requirements of the supplier's software. If any departures from the specifications are deemed necessary, details of such departures and the reasons shall be submitted to the Owner for review and approval.
- b. Software furnished under this Section shall be the latest revision standard product.
- c. This specification describes the minimum software requirements. Where the software supplier's standard configuration includes additional features not specifically described herein, they shall be furnished as part of the software package.
- d. The design of software furnished shall utilize concepts, techniques, and features which provide maximum reliability and ease of troubleshooting. Diagnostic software, if available, shall be furnished to aid in troubleshooting on the system level.
- e. The software shall be distributed on standard 3-1/2-inch floppy diskettes and shall allow the user to copy the diskettes for backup. Any copy protection shall be a hardware key only.
- f. Documentation shall be included that thoroughly explains how to load, configure, and use the specified software. The documentation shall be indexed and provided in a hard bound cover such as a three ring binder.

2. Overview:

- a. The software shall be used for data acquisition, text and graphic data display, alarming, realtime and historical trending, and report generation of process data from several Modicon 984-145 Programmable Logic Controllers (PLC). The software shall also function as an operator interface to the PLC controlled processes.
- b. A personal computer (PC) shall be used as the process graphic display and the interface to the software functions. The PC shall communicate over a Modbus Plus multidrop serial link to each of the PLCs. As a minimum, the PC shall be used for the following functions:
 - (1) Communication to, and information retrieval from the PLCs;
 - (2) Viewing of the process database status indicators such as loop status, and equipment status;
 - (3) Alarm display, logging, and acknowledgement;
 - (4) Viewing real time trends; and

- (5) Activation of the data retrieval system to get information and display trends from the Historical Data Files.

3. Process Interface:

- a. The software package shall be an integrated set of software modules that are designed to run on an IBM compatible PC utilizing a 486DX CPU. The core of the package shall be a memory resident realtime data base that is structured as function blocks and which is configured by fill-in-the-blank keyboard entries. All function blocks shall be identified with a tag name having a minimum of nine alphanumeric characters.
- b. The package shall run under Microsoft's MS-DOS 6.0 or later and Windows 3.1. It shall include a means for running multiple tasks in the background concurrently while the foreground program is running. The user shall be able to revise the database on-line while the system is operating. The software shall be designed to interface with standard spreadsheet and database programs, such as Microsoft EXCEL and DBase IV with a minimum of custom programming.
- c. The software package shall provide the following as a minimum:
 - (1) Database Updating:
The main background task shall be to update the database continually by communicating to the PLCs to obtain process information.
 - (2) Alarm Manager:
The software shall be configurable to produce alarm messages based on specific conditions that occur in the database. The software shall have the capability to direct the message to the PC monitor, a printer connected to the PC, and/or a disk file as configured by the user. The software shall also have the capability to cause the PC to audibly alarm ("beep") whenever an alarm occurs and to change color on the graphic display according to alarm status. The user shall be able to enable or disable any alarm on a point-by-point basis. When displayed on the screen, the alarms shall flash until acknowledged. Acknowledgement shall be on a point-by-point basis. The software shall also provide between 1 and 999 prioritized alarms configurable by the user, and an alarm sub-group hierarchy.
 - (3) Graphic Display:
The software shall display user selected information from the process database automatically on user created color graphic displays. The user, through the graphic display, shall be able to

acknowledge alarms, call up different displays, or request printed output. A password protection or authorization level scheme shall be provided to prevent accessing of protected displays by unauthorized personnel. User interaction with the PCs shall be made through the PC keyboards or through a mouse. For keyboard entries, function keys shall be the method routinely used to access PC displays. The mouse shall be used to point to and click on targets.

- (4) **Graphics Editor:**
The editor shall use either object oriented graphics to build process displays. The software shall be compatible with Video Graphics Adaptor (VGA) hardware or better, and shall support a minimum of 16 foreground colors and 8 background colors. The number of displays shall be limited only by memory storage space. The user shall be able to cut and paste, edit or erase screen areas within a display, and read or write symbols or subpictures to memory storage.
- (5) **Realtime Trending:**
Realtime trending shall be an automatic background task that collects user selected data samples from the database and presents the data in a graphical trend display. The task shall be capable of displaying a minimum of four trended variables on a single time-value graph with each point displayed with a different color. The trending display shall have the capability of being scaled in engineering units and shall include a movable time cursor that provides the exact value of the variable at the selected point. The trending display shall also include chart shift, pan, and zoom, and the capability to print the display on a color printer when requested by the user.
- (6) **Historical Trending:**
The historical trending task shall be an automatic background task that collects user selected data samples from the database and stores them in a disk file along with the sample's tag name and time of sample. The display shall have the same specifications as described under Realtime Trending with the additional requirement that the user shall have the capability to print user configured trend graphs automatically at a user preselected time.
- (7) **Task Scheduler:**
This feature shall enable the user to schedule tasks such as daily or monthly report, based on either time and date, or an event that occurs in the database.
- (8) **Report Generator:**
The user shall be able to define a report on-line and then have

the report generated on-demand or automatically by the scheduler specified above. The report shall be organized on a page-by-page basis and shall be directed to the PC monitor, system printer, or to a disk storage file.

(9) Statistical Process Control/Statistical Quality Control (SPC/SQC):

The user shall be able to compare actual process performance against statistical standards with all charts and limits user configurable.

(10) Recipes:

The user shall be able modify and download a recipe (process variables such as set points and process limits) to any of the PLCs.

(11) Windows Dynamic Data Exchange (DDE) and NETDDE:

The software shall have the capability to share data with other Windows applications on the same PC via DDE and via NETDDE with Windows applications residing on different PCs networked together over any standard NETBIOS network or connected over a serial communication link.

(12) Modbus Plus Network Interface:

The software shall communicate over a Modbus Plus serial link to the networked PLCs. The communication task shall be able to obtain all process information available from the PLCs and be able to write information representing operator interface commands to a selected PLC.

4. Local Area Network Access:

- a. The software package shall have built-in network security features to prevent unauthorized access to process data from remote nodes.

5. Future Expansion:

- a. The software package shall be capable of interfacing at any time to additional devices with minimum reconfiguration and interruption of existing process interface applications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wonderware Corporation
100 Technology Drive
Irvine, California 92718

2.02 DISTRIBUTORS

- A. To be determined at time of bid.

2.03 COMPONENTS

- A. InTouch Standard Runtime System with I/O Version 4.0 or later version.
- B. Modbus Plus DDE Server Version 4.01 or later version.

2.04 SOURCE QUALITY CONTROL

- A. Manufacturer shall test and verify the conformance of all products listed to the specifications contained in the latest InTouch product bulletin and Modbus Plus DDE Server data sheet.

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 13480

VARIABLE FREQUENCY DRIVE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specification requirements for field mounted elements of alternating current (AC) inverter type variable frequency drive (VFD) used to control torque and speed of an alternating current motor.
- B. Specification requirements for drive options and accessories.

1.02 REFERENCES

- A. The following codes and standards are generally applicable to the products of this section:
 - IEC - International Electrotechnical Commission
 - IEEE - Institute of Electrical and Electronics Engineers
 - NEC - National Electrical Code issued by the National Fire Protection Association (NFPA)
 - NEMA - National Electrical Manufacturers Association
 - UL - Underwriters Laboratories

1.03 SUBMITTALS

- A. Provide the following as a minimum with delivery of specified components and ship under separate cover to Owner:
 - 1. Operation and Maintenance Manual (one per drive) including but not limited to:
 - a. Data for each component showing electrical characteristics and connection requirements;
 - b. Operating and programming instructions;
 - c. Instructions for component sub-assembly replacement, adjustments, calibration, preventive maintenance procedures and materials.
 - 2. Certified drawings showing outline dimensions, mounting options and mounting accessories, if not included in Operation and Maintenance Manual.
 - 3. Certificates of compliance.
 - 4. Certified test reports.

5. Warranties for each component.
6. Name, address, and telephone number of the nearest repair facility and information for obtaining on-site service.
7. List of replacement parts and accessories for each component and recommended spares, if not included in Operation and Maintenance Manual.

1.04 SYSTEM DESCRIPTION

A. General:

1. The VFD shall be capable of regulating the output voltage and frequency to any standard 3-phase AC motor, rated by the motor manufacturer as suitable for use with a VFD, to control motor torque and speed.

B. Operation:

1. The VFD shall consist of three main sections:
 - a. the Converter Section containing a diode rectifier bridge and filter to change the incoming 3-phase fixed frequency and voltage AC line power to a fixed voltage direct current (DC) bus;
 - b. the 3-phase insulated gate bipolar transistor (IGBT) based Inverter Section to change the filtered DC bus into a sine-coded adjustable 3-phase pulse width modulated output; and
 - c. as a minimum, a 16-bit microprocessor based Regulator Section to perform the logic, measurement, and control necessary to integrate the drive elements into a system.
2. The VFD shall be totally digital with no manual adjustments required on any printed circuit board. All parameter adjustments shall be by digital entry through a locally mounted keypad or serial communication link.
3. All printed circuit boards used in the VFD shall employ surface mount technology and conformal coating for high reliability.
4. The VFD shall be provided in a NEMA 1 enclosure which shall be mountable on a wall or in a panel.

1.05 WARRANTY

- A. Provide manufacturer's standard warranty for a minimum period of three years.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. A firm regularly and currently engaged in design and manufacture of similar equipment.

2. Equipment shall be new and of current design.

B. Materials and Installation:

1. The VFD and all options shall be UL listed according to Electric Industrial Control Equipment Specification UL 508. A UL label shall be attached inside each enclosure as verification.
2. The VFD and all options shall comply with the applicable requirements of referenced electrical codes and standards. Codes and standards referred to shall be used for establishing minimum quality of the materials and equipment supplied and installed.
3. Capacities of equipment shall not be less than that indicated.

1.07 MAINTENANCE

A. Maintainability:

1. The VFD shall be designed for ease of maintenance. Access to critical parts shall not require major disassembly.
2. The VFD shall be totally operational with no motors connected.

B. Maintenance Service:

1. Manufacturer or Distributor shall offer a means for replacement or repair maintenance service for the VFD within 24 hours or less. This may be in the form of an on-site maintenance agreement or a program providing overnight shipment of replacement equipment with a return to factory of defective items.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Tag No.: See TABLE "A" (Attachment I)
2. Service: See TABLE "A" (Attachment I)

B. Design Features:

1. Output Type: Sine-coded, pulse width modulated
2. Control Logic Type: 16-bit microprocessor based, as a minimum
3. Carrier Frequency: Adjustable between 0 and 10,000 Hertz
4. Volts/Hertz Ratio: Fixed or adjustable, user selectable
5. Local Operator Interface: Sealed touch pad

6. Local Operator Display: Digital liquid crystal display
7. Remote Interface: Modbus Plus serial communication link, (See Options, Par. 2.01-E)
8. Remote Speed Reference: 0-10 Volts DC or 4-20 milliamperes and digital data over serial link
9. Drive Analog Monitor Output: At a minimum, 0-10 Volts DC or 4-20 milliamperes proportional to output frequency or current; and equivalent digital data available over serial link
10. Drive Digital Monitor Output: At a minimum, one contact rated for 1 ampere at 250 Volts AC or 30 Volts DC indicating drive fault; and equivalent digital data available over serial link

B. Performance Requirements:

1. Motor Type: See TABLE "A" (Attachment I)
2. Required Horsepower: See TABLE "A" (Attachment I)
3. Load Type: See TABLE "A" (Attachment I)
4. Approximate Motor Lead Length: See TABLE "A" (Attachment I)
5. Maximum Output Voltage: Equal to 3-phase input voltage
6. Nominal Output Frequency: 0.1 to 400 Hertz
7. Minimum Speed Adjustment: 0.1 to 80 Hertz
8. Maximum Speed Adjustment: Minimum speed to 400 Hertz
9. Acceleration Time: Adjustable 0.2 to 1000 seconds minimum, or longer
10. Acceleration Ramp Type: Linear, at a minimum, plus manufacturer standard types
11. Deceleration Time: Adjustable 0.2 to 1000 seconds minimum, or longer
12. Deceleration Ramp Type: Linear, at a minimum, plus manufacturer standard types
13. Critical Frequency Rejection: 3 selectable with adjustable bands
14. Preset Speeds: 3 minimum
15. Starting Torque Capability: 100 percent available from 0.5 to 60 Hertz

- 16. Torque and Current Limit Capability: Adjustable 0 to 150 percent
- 17. DC Injection Braking: Provide manufacturer standard DC injection braking
- 18. Efficiency at 100 Percent Speed: Not less than 96 percent
- 19. Auto Restart Attempts: 0 to 5, programmable
- 20. Fault Memory: Store fault type and run status of at least 5 past faults
- 21. Program Security Code: 0 to 9999, programmable, or equivalent
- 22. Power Loss Ride-Thru: 0.5 seconds or greater
- 23. Harmonic Distortion: 5 percent or less; provide line reactors or isolation transformers

C. Service Conditions:

- 1. Input Voltage: 460 Volts AC plus or minus 10 percent, 3-phase, 3-wire, phase sequence insensitive
- 2. Frequency Input: 60 Hertz
- 3. Ambient Operating Temperature: Minus 14 to plus 60 degrees Centigrade
- 4. Humidity: 0 to 90 percent non-condensing, over ambient temperature range

D. Protective Features:

- 1. Output current overload rating of 125 percent of motor full load amperes for 60 seconds.
- 2. Phase-to-phase and phase-to-ground protection such that neither fuse blowing nor component damage can occur.
- 3. Internal short circuit protection on the internal power supplies and the logic and analog outputs.
- 4. Instantaneous overcurrent, bus overvoltage and bus undervoltage protection.
- 5. Automatic testing on power-up of microprocessor, memory, all critical internal circuits, and option modules.
- 6. Orderly shutdown of the VFD upon any VFD fault without fuse blowing or component damage.
- 7. Automatic restart synchronizing of the VFD output to a spinning motor by sensing motor frequency and rotational direction.
- 8. Shutdown of the VFD on heatsink over temperature with a minimum of 60 seconds pre-shutdown alarm.
- 9. Metal Oxide Varistor (MOV), or equal as a minimum, voltage transient suppression on diode bridge converter section.
- 10. VFD shall fault and/or operate at a user defined speed upon loss of external speed reference information.

E. Options:

- 1. The VFD shall be provided with a Modicon approved Modbus Plus

compatible serial communication module which shall permit the VFD to appear as a standard node on a Modbus Plus network. The module shall be installed on or within the VFD without the need for interconnect wiring, external power supply or additional panel space. All VFD programmable functions and monitored data outputs shall be available through the Modicon 984 programmable logic controller ladder logic "MSTR" function block.

2.02 SOURCE QUALITY CONTROL

A. Factory Testing and Calibration:

1. Manufacturer shall functionally test all individual printed circuit board assemblies via computerized test equipment.
2. All printed circuit boards shall be burned in for 96 hours at 85 degrees Centigrade.
3. Manufacturer shall test the fully assembled drive with an induction motor fully loaded to the rating of the drive to insure that all printed circuit boards and other components are properly mounted; are of the correct value; are functioning normally; and that default programmable parameters and drive performance parameters are as specified by the Manufacturer. Each drive shall be run fully loaded for a period of 4 hours without a shutdown. Any fault or failure causing the VFD to shut down shall be investigated, corrected, and the test restarted from the beginning. A certified test report for each VFD shall be submitted to the Owner for review.

2.03 ACCEPTABLE MANUFACTURERS

- ### A. Square D Company Altivar 66 or approved equal

PART 3 EXECUTION

3.01 INSTALLATION

- ### A. Installation shall be in accordance with the manufacturer's instructions and approved drawings.
- ### B. Before and during the installation, the VFD equipment shall be protected from site contaminants.

- C. The Manufacturer shall provide a factory certified technical representative to inspect the Contractor's installation of the drives furnished under this specification and assist during checkout, commissioning and start-up for a maximum total of 30 days. This service shall be quoted as a separate item.

END OF SECTION

Attachment I, TABLE "A", 1 page

Attachment I
TABLE "A"
Variable Frequency Drives

Tag No.	Service	Motor Type	Required Horsepower	Load Type	Approx. Motor Lead Length ft
SIC-110	Extraction Well 110 Pump	Submersible Water Well	To Be Determined	To Be Determined	TBD
SIC-120	Extraction Well 120 Pump	Submersible Water Well	To Be Determined	To Be Determined	TBD
SIC-130	Extraction Well 130 Pump	Submersible Water Well	To be Determined	To Be Determined	TBD
SIC-140	Extraction Well 140 Pump	Submersible Water Well	To be Determined	To Be Determined	TBD
SIC-210	Transfer Pump Equalization Tank	To Be Determined	7.5	To Be Determined	TBD
SIC-211	Transfer Pump Equalization Tank	To be Determined	7.5	To Be Determined	TBD
SIC-310	Transfer Pump Backwash Tank	To Be Determined	7.5	To Be Determined	TBD
SIC-311	Transfer Pump Backwash Tank	To Be Determined	7.5	To Be Determined	TBD

SECTION 15051
WALL PIPES, FLOOR PIPES AND PIPE SLEEVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, mechanical seals and escutcheons required to complete the Work.

1.2 RELATED SECTIONS

- 1. Section 03300, Concrete.
- 2. Section 09900, Painting.
- 3. Division 15, Sections on Piping Valves and Specials.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.
 - 1. AWWA C100, Cast Iron Pressure Fittings.
 - 2. AWWA C104 (ASNI A21.4), Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water.
 - 3. AWWA C106 (ANSI A21.6), Cast Iron Pipe Centrifugally Cast in Metal Molds, for Water and Other Liquids.
 - 4. AWWA C110 (ANSI A21.6), Gray-Iron and Ductile-Iron Fittings, 2 in. through 48 in., for Water and Other Liquids.
 - 5. AWWA C111 (ANSI A21.11), Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.
 - 6. AWWA C115 (ANSI A21.15), Flanged Cast Iron and Ductile Iron Pipe with Threaded Flanges.
 - 7. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

8. AWWA C200, Steel Water Pipe 6 Inches and Larger.
9. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
10. ANSI B16.4, Cast Iron Screwed Fittings.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Detailed drawings and data on all wall and floor pipes, and pipe sleeves.
 2. Submit and coordinate these with Drawings required for all piping system.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General:
1. On the Drawings, where the type of penetration is not indicated the CONTRACTOR shall use either a typical detail as shown on the Drawings or a detail approved by the Engineer.
- B. Wall and Floor Pipes:
1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise shown on the Drawings or approved by the Engineer.
 2. End Connections: As shown on the Drawings or approved by the Engineer.
 3. Thickness: Same as specified for the piping connected to wall or floor pipe unless otherwise shown or specified.
 4. Provide water stop at mid-point of wall or floor for anchorage and watertightness.
 5. Pipes ends shall be flush with wall or floor face unless otherwise shown.
 6. Flanged ends and mechanical joint bells shall be drilled and tapped for studs. Provide stainless steel studs.

C. Pipe Sleeves: Pipe sleeves shall conform to the details on the Drawings. Where not shown conform to the following as a minimum:

1. Provide sleeves of Schedule 40 black steel pipe or cast iron. Ends of the sleeve shall be cut square and reamed smooth. Sleeves 3 inches and larger shall have steel anchor lugs welded to the pipe for embedment into masonry and concrete.

D. Mechanical Seals: Provide link-type mechanical seals with adjusting bolts in all pipe sleeves unless otherwise approved by CONTRACTOR suitable for 20 psi working pressure.

1. Type: Mechanical seals through non-fire rated walls or floors:
 - a. Pressure Plate: Glass reinforced nylon plastic.
 - b. Bolt and Nut: type 316 stainless steel.
 - c. Sealing Element: EPDM rubber.
2. Type: Mechanical seals through fire rated walls or floors; two independent mechanical seal assemblies required:
 - a. Pressure Plate: Low carbon steel, zinc galvanized plated.
 - b. Bolt and Nut: LOW CARBON STEEL ZINC GALVANIZED.
 - c. Sealing Element: Silicon rubber.
3. Manufacturer: Provide seals of one of the following:
 - a. Thunderline Corporation
 - b. Or equal.

E. Wall, Floor and Ceiling Plates:

1. Pipes passing through wall, floors and ceiling in finished rooms shall be provided with escutcheon plates of cast brass or cast iron nickel plated, hinged with set screws.

2.2 SURFACE PREPARATION AND PAINTING

- A. All exposed surfaces of wall pipes, floor pipes and pipe sleeves shall be prepared and painted in accordance with the requirements of Section 09900.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.
- B. Pipe Sleeves:
 - 1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs unless otherwise shown.
 - 2. In process areas all sleeves through floor slabs shall extend a minimum of 2-inches above finished floor.
 - 3. In finished areas all sleeves through floor slabs shall extend a maximum of 1/4-inch above finished floor.
 - 4. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
 - 5. Sleeves through walls shall be flush with wall face.
 - 6. Seal annular space between pipe and sleeve with mechanical seals or as approved by CONTRACTOR.
 - 7. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
 - 8. Size sleeves to provide annular space as recommended by the mechanical seal manufacturer and as follows:

Pipe Size

Spacing between Sleeve
ID and Pipe
Or Insulation OD

Less than 2 in.
2 in. - 4 in.
6 in. - 12 in.
Over 12 in.

1/2 in. to 3/4 in.
3/4 in. to 1-1/4 in.
1-1/4 in. to 2 in.
2 in. to 3 in.

10. Do not install sleeves and pipes through concrete and steel members unless specifically shown and approved by CONTRACTOR.

END OF SECTION 15051

SECTION 15060
SVE PIPING AND APPURTENANCES

1 PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Specification and all applicable specifications, Drawings, standards, and codes referenced herein shall apply to the fabrication and erection of all piping, pipe fittings, valves, supports, etc., and any prefabrication for the following systems:
 - 1. Inlet Extraction Manifolds (VES Trailer).
 - 2. Coaxial Vapor and Groundwater Extraction Piping (Extraction Wells to Vapor and Water Extraction Manifolds).
 - 3. Water Discharge Piping (Water Discharge Pumps to Equalization Tank)
 - 4. Interconnecting piping through entire SVE system train (SVE Trailer).
 - 5. Natural gas service connection (SVE Vapor-Phase Treatment System).
- B. Conformance
 - 1. All work within the scope of this Specification shall be performed in accordance with this Specification and all applicable referenced documents. No deviations shall be made from this Specification or any applicable referenced documents without prior written authorization of the Engineer for each deviation. the application for each deviation shall completely and specifically define the location of, the nature of, and the reason for the proposed deviation.
- C. Specifications
 - 1. All specifications, standards, codes, etc., referred to and designated herein, together with all addenda, revisions, and supplements, shall be considered part of this Specification. Specifications, standards, codes, etc., referred to shall be of the latest edition.
 - 2. All materials, fabrication, assembly, testing, and inspection of the piping systems within the scope of this Specification shall be in accordance with the ANSI Code for Pressure Piping B31.3; and the Contract Piping Materials Specification.

3. All conflicts between the requirements of this Specification, related specifications, standards, purchase orders, design drawings or models shall be referred to the Engineer before proceeding with work of the affected parts.
4. Nothing in this Specification shall be interpreted as in any way relieving a Contractor of the responsibility for complete compliance with the referenced codes wherever they apply.

1.2 RELATED SECTIONS

- A. Section 02220 - Excavation and Backfill.
- B. Section 15141 - SVE System Supports and Anchors.
- C. Section 15260 - Piping Insulation.

1.3 REFERENCES

- A. ANSI B31.1 - Power Piping.
- B. ANSI B31.2 - Fuel Gas Piping.
- C. ANSI B31.9 - Building Service Piping.
- D. ANSI B16.5 - 1981 - Steel Pipe Flanges and Flanged Fittings "American Class 150, 300, 400, 600, 900, 1,500, 2,500 Steel Flange Standards".
- E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- F. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- G. ANSI B2.1 - Pipe Threads.
- H. ANSI B16.3 - Malleable Iron Threaded Fittings.
- I. ASTM B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
- J. ASTM B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
- K. ASTM B16.21 - Nonmetallic Gaskets for Pipe Flanges.
- L. ASTM B16.25 - Buttwelding Ends.

- M ASTM B31.3 - Pressure Piping Code.
- N ASTM D-2146 - Polypropylene Pipe Manufacturing.
- O ASTM D-2837 - Hydrostatic Design Basis for Polypropylene Pipe.
- P ASTM D-4101 - Material for Polypropylene Pipe and Fittings.
- Q ASME (Applicable Sections) - Welding and Brazing Qualifications.
- R DIN 16962 - Dimensions and Tolerances for Polypropylene Socket Fusion Fittings.
- S ISO 7279 - Dimensions and Tolerances for Polypropylene Socket Fusion Fittings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Evidence of Fusion Training and Certification for polypropylene piping installation, by polypropylene piping manufacturer.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720.
- B. Record actual locations of valves.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 1730.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

- C. Welders Certification: In accordance with ASME Sec 9.
- D. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum three (3) years documented experience.
- C. Polypropylene Piping Installer: Installer(s) shall be factory trained and certified for polypropylene piping installation and fusion welding.

1.9 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of Rhode Island plumbing code.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Sections 01610 and 01540.
- B. Accept valves on site in shipping containers with labelling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding materials are wet or frozen.

1.13 EXTRA MATERIALS

- A. Provide one (1) repacking kit for each size valve.

2 PART 2 PRODUCTS

2.1 GROUNDWATER AND VAPOR EXTRACTION SYSTEM AND WATER DISCHARGE PIPING

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black (galvanized for groundwater service)
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type (galvanized for groundwater service).
 - 2. Joints: NFPA 54, threaded or welded to applicable portion of ANSI B31 and ASME Sec 1.
- B. Grooved End Steel Pipe - black schedules 10, 40, 80 steel (as indicated on the contract drawings), ASTM, A-135 OR A-53, Grade B, 3/4 to 1-1/2" Type F and 2-24" Type E or S, or hot-dip galvanized for groundwater service.
 - 1. Fittings: shall be Victaulic Company of America, Easton, PA., full flow cast fittings, steel fittings or segmentally welded fittings with grooves or shoulders designed to accept Victaulic grooved end couplings (designate specific style numbers).
 - a. Standard Fittings - Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12), or malleable iron conforming to ASTM A-47, Grade 32510, painted with alkyd enamel or hot-dip galvanized to ASTM A-153 or zinc electroplated to ASTM B-633.
 - i. Bolted Branch Outlets shall be Victaulic Style 920 Mechanical-T.
 - b. Standard Segmentally Welded Fittings - Shall be fabricated of Schedule 40 carbon steel pipe as follows: 3/4 to 1-1/2" conforming to ASTM A-53, Type F; 2-10" Schedule 40 conforming to ASTM A-53 Type E or S, Grade B; 12-24" 0.375" wall conforming to ASTM A-53, Type E or S, Grade B, painted with rust inhibiting modified vinyl alkyd enamel or hot-dip galvanized to ASTM A-153.
 - 2. Joints: grooved, prepared in accordance with (ANSI/AWWA C-606), (CSA B242-M1980), (MIL-P-11087C Grooved End Pipe) or Victaulic (manufacturer's) published specifications as appropriate according to pipe material, wall thickness, size and method of joining. In the event of conflict, Victaulic data shall prevail.
- C. Polypropylene Pipe: Manufactured from a Type II copolymer meeting ASTM D-4101 in accordance with ASTM D-2146. Shall conform to requirements of DIN 8077 and ASTM D-2837.

1. Fittings: Socket fusion type in accordance with ISO 7279 and DIN 16962 dimensions and tolerances. Type I homopolymer meeting ASTM D-4101 in accordance with ASTM D-2146.
 2. Joints: Heat fusion in accordance with pipe manufacturer recommendations.
- D. Chemical Hose: Groundwater Extraction "Straw" shall be 1" ID Goodyear Dayco Series 7276 Poly Chem Hose. Hose shall be run continuous without joints or couplings except at termination interfaces with the extraction well foot valve and the water extraction manifold.
1. Couplings: Provide 1-5/8" OD X 1" NPTF Swaged SS couplings to interface with the extraction well foot valve and the water extraction manifold (water extraction manifold to be swiveled), by the Swagelok Co., Solon, OH, or equal.
- E. Copper Tubing: ASME SB-42/SB-68 Type L. Soft.

2.2 FLANGES, UNIONS, AND COUPLINGS

A. Grooved Piping Systems

1. Couplings - shall consist of a one or more piece ductile or malleable iron cast housing, a synthetic rubber gasket of a central cavity pressure-responsive design, with nuts, bolts, locking toggle or lugs to secure unit together.
 - a. Coupling Housings - Shall be cast of ductile iron conforming to ASTM A 536 (Grade 65-45-12) or malleable iron conforming to ASTM A-47 (Grade 32510), hot dip galvanized to ASTM A-153, or zinc electroplated to ASTM B-633, as manufactured by Victaulic Company of America.
 - b. Coatings - Shall consist of an alkyd enamel paint, or hotdip galvanizing to ASTM A-153, or zinc electroplating to ASTM B-633, as specified.
 - c. Couplings for Grooved End Steel Pipe - Shall be Victaulic couplings for grooved end steel pipe.
 - d. Line and Fitting Joints - Shall be Victaulic flexible (Style 77) or rigid (Style 07), as indicated on the contract drawings.

- e. Reducing Joints - Shall be Victaulic Style 750 Reducing Couplings for pipe to pipe joints or to create reducing fittings using straight fitting configurations.
 - f. Flanged Connections - Shall be Victaulic Style 741 (2-24") Vic-Flange adapters, engaging directly into grooved pipe and bolting directly to ANSI Class 150 steel flanged components.
 - g. Quick Disconnects - Shall be Victaulic Style 78 Snap-Joint Couplings or Style 780/781 for double grooved pipe.
2. Gaskets - shall be molded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the pipe outside diameter and coupling housing, of elastomers having properties as designated in ASTM D-2000. Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.
- a. Special Chemical Service (grooved piping handling extraction well vapor and groundwater (including water discharge piping) - gasket supplied for special chemical services from +20°F to +300°F, shall be a Grade "O" fluoroelastomer (Viton) compound, with blue color code, molded of materials conforming to ASTM D-2000, designation 2HK714A110B27EF31Z, recommended for many oxidizing acids, petroleum oils, halogenated hydrocarbons, lubricants, hydraulic fluids, organic liquids and air with hydrocarbons to +300°F.
 - b. Vacuum Service - Gasket supplied for vacuum service shall be Victaulic Flush-Seal® style or standard gaskets with internal metal liner.
3. Fasteners
- a. Bolts and Nuts - Bolts and nuts shall be heat treated carbon steel, track head, conforming to physical properties of ASTM A-183 minimum tensile 110,000 psi, black, or zinc electroplated to ASTM B-633.
 - b. Other Fasteners - Fasteners for certain products may vary from this specification, as noted with each project.
- B. Pipe Size 2 Inches (50 mm) and Under:
- 1. Ferrous pipe: 150 psig (1 034 kPa) malleable iron threaded unions (galvanized for water service).

C. Pipe Size Over 2 Inches (50 mm):

1. Ferrous pipe: 150 psig (1 034 kPa) forged steel slip-on flanges; 1/16 inch (1.6 mm) thick preformed neoprene gaskets.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 GLOBE VALVES

A. Eng. Tag HV-060

Up to and including 2 Inches (50 mm): Bronze body, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, screwed ends, with back seating capacity (repackable under pressure).

2.4 BALL VALVES

A. Eng. Tags HV-046A-F, 047, 048, 049, 050, 054, 055, 056, 057, 058, 059, 061, 062, 063, 075, 076

Up to and including 2 Inches (50 mm): Bronze body, chrome plated steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends. Water Extraction Ball Valves shall be rated to no less than 29" HG Vacuum as required for intended service.

Manufacturer/Model: Apollo (Division of Conbraco Industries, Inc., Pageland, S.C.) 70-100 Series 101-108, or equal.

2.9 BUTTERFLY VALVES (Manual Operator)

A. Eng. Tags 051(Manual On/Off), HV-045A-F, 052, 053(Manual Infinite Positioning)

Up to and including 6 Inches (152 mm): Wafer style, angle disc style, full circle sealing between disc and seat, bubble tight shutoff, blowout-proof shaft, complete with manual lever operator, infinite positioning. Shall be rated to no less than 15" HG Vacuum as required for intended service. Cast iron body, aluminum bronze disc, 316 SS shaft, aluminum bronze seat, manual on/off or manual infinite positioning operator.

Manufacturer/Model: Norriseal, Houston, TX,

6" On/Off - M1010-423B-1A

3" or 6" Infinite Positioning - M1010-423B-1E

2.10 MOTOR ACTUATED BUTTERFLY VALVES

A. Vapor Extraction Manifold: Eng. Tags 051 FV-012A-F

3 Inches (152 mm): Wafer style, angle disc style, full circle sealing between disc and seat, bubble tight shutoff, blowout-proof shaft, complete with manual lever operator, infinite positioning. Shall be rated to no less than 15" HG Vacuum as required for intended service. Cast iron body, aluminum bronze disc, 316 SS shaft, aluminum bronze seat. Valves provided with reversing electric operator with NEMA 7, explosion-proof capability.

Manufacturer/Model: Norriseal(Houston, TX), 3" valve with El-O-Matic(Hackensack, NJ) Electric Operator, complete model No.: 3" M1010-423B-EL-35-XP

B. Dilution Air Manifold: Eng. Tag FV-014

Vendor supplied, refer to Section 11350 SVE Vapor-Phase Treatment System

2.11 SOLENOID ACTUATED VALVES

A. Eng. Tag SV-011A-F, 030, 033

Provide 1", two (2) way, normally closed, aluminum body, viton seals and discs, 305 S.S. core tube, 430F S.S. core and plugnut, 302 s.s. springs, copper shading coil, acetal core guide and Teflon filled rider ring. Nominal ambient temperature ranges (32° F to 125° F). Combination explosion proof and raintight enclosure, 120 volts, AC, 60 Hz. Coil shall be continuous duty molded Class F. Shall be mounted with solenoid vertical and upright. Shall be rated to 29" HG Vacuum service Minimum.

Manufacturer: ASCO(Automatic Switch Co.), Florham Park, NJ.

2.12 CHECK VALVES

A. Spring Loaded: Eng. Tags FV-065, 066, 067, 068, 070, 073, 077

Brass body, SS spring, bronze piston bubble-tight shutoff, 1/2 psi cracking pressure, with viton seals and screwed ends. Valves shall be rated for no less than 29 " HG vacuum service.

Manufacturer: Conbraco Industries, or equal.

B. Swing Check: Eng. Tags FV-011-A-F

Brönze body and disc with viton seals and screwed ends. Valves shall be rated for no less then 29 " HG vacuum service.

C. Wafer Check: Eng. Tag FV-071

6" wafer style 125 flange class, aluminum body and internals with viton seals and 304 SS spring.

Manufacturer/Model: Technochek Style 5412-6"

2.13 EXTRACTION WELL FOOT VALVE

A. Eng. Tags FV-074A-F

Shall be 1" nominal size, stainless steel body, viton check sleeve material (duck bill style), threaded stainless steel end connections. 100% shutoff on flow reversal.

Manufacturer/Model: Red Valve Company, Inc., Series 2633, In-Line check Valve.

2.14 PRESSURE RELIEF/BY-PASS CONTROL VALVES

A. Eng. Tag PCV-043

Bronze body, teflon seat, steel stem and springs and/or diaphragm compatible with 1%Toluene, automatic, direct pressure actuated, and field adjustable.

Manufacturer: Watts Industrial Products, or equal.

2.15 VACUUM RELIEF SAFETY VALVES

A. Eng. Tag PCV-013

Provide M-D Pneumatics 3" threaded connection adjustable setting vacuum relief valve, model NO. 1362-8. Connect to dilution air piping utilizing bell reducers, provide unions or other means to allow for future removal. Initial relief setting shall be 10.5"HG vacuum.

B. Eng. Tag PCV-044

Provide GAST Manufacturing Corp., Benton Harbor, MI, 3/8" threaded connection adjustable setting vacuum relief valve, model No. AA840A. Initial relief setting shall be 28" HG vacuum.

3 PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations under provisions of Section 02220.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. [Bevel plain end ferrous pipe.]
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried piping outside the building to ensure cover of not less than the minimum frost depth in the project area.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Support for utility meters shall be provided by Providence Gas Company.
- L. Prepare pipe, fittings, supports, and accessories (not prefinished), ready for finish painting.
- M. Excavate in accordance with Section 02220 for work in this Section.

- N. Backfill in accordance with Section 02220 for work of this Section.
- O. Install bell and spigot pipe with bell end upstream.
- P. Install valves with stems upright or horizontal, not inverted.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream or grooved fittings both up and downstream of valves and at equipment or apparatus connections .
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers or as otherwise indicated on the contract drawings.
- E. Install globe or butterfly valves for throttling, bypass, or manual flow control services or as otherwise indicated on the contract drawings.
- F. Provide spring loaded check valves on discharge of water discharge pumps.
- G. Provide plug valves in Natural Gas System for shut-off service.

3.5 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for vapor extraction pipe condensate drainage to 1/8 inch per foot (1 percent) minimum, towards extraction wells. Maintain gradients.
- B. Slope water piping and arrange to drain at low points.

3.6 DISINFECTION OF WATER SERVICE PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 2 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

- A. Provide new gas service piping from gas meter, corrector and regulators (provided by Providence Gas Co.) to gas cock provided with the vapor phase treatment unit, in accordance with local Fire Marshal requirements.

END OF SECTION 15060

SECTION 15080
PIPING SMALLER THAN 4 INCHES IN DIAMETER

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install.

1.2 GENERAL

- A. In general, schematic diagrams for the small piping systems are shown on the Drawings. It is the intention of the Drawings and of these Specifications that CONTRACTOR shall provide complete and workable small piping systems and any miscellaneous valves and fittings required for proper completion of the work shall be considered as having been included.
- B. The Drawings show the general layout of small piping diagrammatically and do not necessarily reflect the exact location of the various items. Accordingly, CONTRACTOR should not scale the Drawings but shall acquaint himself fully with the extent and character of the work required and its relation to the work under other sections.
- C. All bolts, nuts, gaskets, wall sleeves, hangers, brackets, and other supports required for piping and equipment furnished under this Section shall be provided by CONTRACTOR.
- D. The piping schedule for all pipe is included at the end of Section 15090.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the standards listed hereinafter under Item 2.3 MATERIALS".

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Tapped holes or tee fittings shall be provided in piping where required for connection of gages, switches, sample lines, and similar items. Where wall thickness is insufficient for the tap size required, a boss, tee or tapping saddle shall be provided.

2.2 PIPING SCHEDULE

- A. Polyvinyl Chloride (PVC) Pipe: NaOH, H₂O₂ and polymer transfer piping system.
- B. Kynar (PVDF) Pipe: H₂SO₄ Acid Transfer piping system.
- C. Steel Pipe: Compressed Air Supply Header, Sludge Transfer and Selected Groundwater Transfer.

2.3 MATERIALS

- A. Polyvinyl Chloride (PVC) Pipe: PVC pipe shall meet ASTM D-1784. Thickness Class shall be Schedule 80. All special sections and fittings shall be made with component parts having the dimensions, ends, and other details as shown and specified. All fittings shall have the same minimum wall thickness as the pipe. Each piece of pipe and all fittings shall be completely cleaned before installation.
- B. PVDF pipe shall meet ASTM D-1434 Thickness Class shall be Schedule 80. All special sections and fittings shall be made with component parts having the dimensions, ends, and other details as shown and specified. All fittings shall have the same minimum wall thickness as the pipe. Each piece of pipe and all fitting shall be completely cleaned before installation.
- C. Compressed Air Supply Header Pipe: Steel, schedule 80, threaded.
- D. Groundwater/Backwash Transfer Piping: Steel, schedule 80, flanged, 150#.

2.4 MANUFACTURERS

- A. Polyvinyl Chloride (PVC) & Kynar (PVDF) Piping:
 - 1. Plastic Engineered Products, Inc.
 - 2. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. CONTRACTOR shall take special care in the arrangement of piping secure a neat and workmanlike appearance and true alignment and grade. All pipe and fittings shall be thoroughly cleaned before erection, and all burrs, scale, fins and obstructions shall be

moved. The CONTRACTOR shall make ample provision to allow for expansion of piping without undue strain.

- B. All piping shall be assembled accurately from measurements established at the job site and worked into place without springing or forcing.
- C. All drain lines shall slope a minimum of one (1) percent in the direction of flow unless otherwise noted.
- D. Bolts, nuts, gaskets and studs for all pipe materials shall be provided as required, and shall conform to the applicable requirements of Section 15090 - "PIPING 4 INCHES IN DIAMETER AND LARGER".
- E. Piping supports, guides and anchors shall be provided for the piping as otherwise required, and shall conform to the applicable requirements of Section 15090 - "PIPING 4 INCHES IN DIAMETER AND LARGER".
- F. Valves shall be installed, in accordance with the manufacturer's specifications.
- G. The exterior of exposed pipe, shall receive surface preparation and field painting in accordance with the requirements of Section 09900, Painting.

3.2 TESTING OF PRESSURE PIPING

- A. Refer to Section 15090.

END OF SECTION 15080

SECTION 15085
VALVES AND SPECIALS SMALLER THAN 4 INCHES IN DIAMETER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install valves and specials for piping smaller than 4 inches in diameter. or as otherwise required.

1.2 QUALITY ASSURANCE

- A. Reference Standards: CONTRACTOR shall comply with applicable provisions and recommendations of the standards listed hereinafter under Article 2.1.

PART 2 PRODUCTS

2.1 MATERIALS

A. PVC Ball Valves:

1. Body: PVC, true union, w/socket fittings, Sch 80.
2. Drive Shaft: stainless steel.
3. Ball: PVC.
4. Seals: Teflon.
5. O-ring: Teflon.

B. PVDF Ball Valves:

1. Body: PVDF, true union ball valve w/socket fusion fitting.
2. Drive shaft: Stainless steel.
3. Ball: PVDF.
4. Seals: Teflon.

5. O-ring: Teflon.

C. PVC Quick Disconnects:

1. Body: PVC.
2. Cam Arms: 316 stainless steel.
3. Gasket: Teflon.
4. Ends:
 - a. Female: Socket.
 - b. Male: Hose Shank.

D. PVDF Quick Disconnects:

1. Body: PVDF
2. Cam Arms: 316 Stainless Steel
3. Gaskets: Teflon
4. Ends:
 - a. Femal: Socker
 - b. Male: Hose shank

E. Carbon Steel Ball Valves:

1. Body: Carbon Steel
2. Drive Shaft: Stainless Steel
3. Seals: Teflon
4. O-Ring: Teflon

F. Check Valves:

1. Body: PVC, Flanged
2. Seal: Viron
3. Spring: Stainless Steel
4. Plate: PVC

2.2 MANUFACTURERS

A. PVC, PVDF Ball Valves, Plug Valves and Quick Disconnects.

1. Plastic Engineered Products, Inc.

PART 3 EXECUTION

3.1 VALVES AND SPECIALS

- A. CONTRACTOR shall install all valves and specials in a neat and workmanlike manner. Heavy units shall be handled by mechanical equipment. Valves or specials which are inadvertently dropped or otherwise damaged prior to OWNER'S representative's final certificate shall be checked by a representative of the manufacturer and replaced or repaired, if required, at CONTRACTOR'S expense.

END OF SECTION 15085

SECTION 15090
PIPING 4 INCHES IN DIAMETER AND LARGER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all piping 4 inches in diameter and larger for the Groundwater Pretreatment System.

1.2 QUALITY ASSURANCE

- A. Reference Standards: CONTRACTOR shall comply with applicable provisions and recommendations of the standards listed hereinafter under 2.1 - "MATERIAL".

PART 2 PRODUCTS

2.1 MATERIALS

- A. Ductile Iron Pipe and Fittings:

- 1. Pipe:

- a. Non-Flanged Pipe: Conform to AWWA C150 and C151 for material, thickness, dimensions, tolerances, tests, marking and other requirements.

- 1) Thickness: Ductile iron pipe and fittings shall be minimum Class 53.

- 2. Joints:

- a. Mechanical Joints: Conform to AWWA C111.

- 1) Gaskets: Plain tip.

- 2) Bolts and Nuts: High strength, low alloy steel.

- b. Push-On Joints: Conform to AWWA C111.

- 1) Gaskets: Molded rubber.

- 2) Strips: Each plain end shall be painted with a circular stripe such that it provides a guide for visual check to determine when the joint is properly assembled.

B. Pipe and Fittings:

1. Pipe, fittings, and couplings shall be of ductile iron.
2. Pipe and fittings shall be furnished with gaskets and bolts. The gaskets shall be teflon ring type, a minimum of 1/8 inch thick, or as required to insure a connection free of leaks at the test pressure. Bolts shall be constructed of stainless steel.
3. Watertight seals between pipe and fitting threads, and flange threads shall be attained by use of a high temperature heat resistant sealing compound. The sealing compound shall be capable of withstanding a minimum firing temperature of 1600 F.

C. PVC Pipe:

1. PVC pipe shall meet ASTM D 1784 thickness class shall be Schedule 80. All special sections and fittings shall be made with components parts having the dimensions, ends and other details as shown and specified. All fittings shall have the same minimum thickness as the pipe. Each piece of pipe and all fittings shall be completely cleaned before installation.

2.2 MANUFACTURERS

A. The Ductile Iron pipe and fittings shall be by:

1. McWone, Inc.
2. Or equal.

B. PVC Pipe and Fittings shall be by:

1. Plastic Engineered shall be by:
2. Or equal.

PART 3 EXECUTION

3.1 PIPE SLEEVES

- A. Where other than cast iron or ductile cast iron pipes pass through building floors, walls, inside partitions or furrings, pipe thimbles, made of 24 gage galvanized steel 3/4-inch larger in diameter than the outside of the pipe for which they are intended, shall be

provided and set in place as grout is installed. Sleeves below grade or through walls of liquid or sludge containing structures shall be cast iron or wrought iron and shall be packed with oakum and lead, and calked watertight. In lieu of calking, the CONTRACTOR may utilize an interlocking modular seal system such as Link-Seal, as manufactured by the Thunderline Corporation, or equal.

- B. Sleeves shall be fastened securely in floors and walls so that they will not be displaced when grouted.
- C. Wall sleeves shall finish flush with finish lines. Floor sleeves not in liquid or sludge containing structures shall be set with bottom flush with finished construction below, and with the top extending 3/4 inch above finished floor. All piping passing through wall or floor sleeves shall be calked watertight.
- D. Ceiling, floor and wall escutcheon plates shall be provided for pipes passing through ceilings, floors and walls in exposed areas.

3.2 INSTALLATION

- A. General: All pipe and fittings shall be placed to the lines and grades shown on the Drawings. All joints shall be clean and shall be made as specified hereinafter. The pipe shall be installed in accordance with the recommendations of the manufacturers.
- B. Taps in Pipe: Taps in piping shall be made for the connection of equipment, gages, and wherever shown on the Drawings or required. The taps may be made either in the shop or in the field. Taps shall be made to the minimum thread length required under ANS B16.1. In cast iron or ductile iron pipe, cast bosses shall be provided should the thickness of the pipe or fittings be less than that required.
- C. Bolts, Nuts, Gaskets, and Studs:
 - 1. All bolts, nuts, studs, gaskets, and other materials necessary for installation of the piping and valves shall be furnished as required.
- D. Pipe Supports:
 - 1. PVC coated pipe supports and hangers shall include pipe hangers, supports, struts, structural members, brackets, plates, anchors and other supports. Acceptable pipe hangers, supports, and brackets shall be provided as necessary for adequate support of all piping. CONTRACTOR shall provide supports of adequate size and strength to support the weight of pipe and liquid and any anticipated thrust.

2. Sizes, weights, anticipated loadings and fabrication details of all supports, be they angles, brackets, struts, structural members, and the like, shall be submitted for review by ENGINEER, but final responsibility for the adequacy of the supports furnished shall remain with CONTRACTOR. In general, pipe supports are not shown on the Drawings, but shall be supplied as specified herein. However, any support details shown on the Drawings shall be followed.
3. Schedule of Pipe Supports:

<u>Pipe</u>	<u>Guide Spacing (ft)</u>	<u>Anchor (Location)</u>
1" PVC/PVDF	3	At all bends
6" PVC	4	At all bends
4" PVC	4	At all bends
1" Steel	6	At all bends

4. The maximum distance between supports for non-PVC piping systems shall be 8 feet for pipe up to 6 inches in diameter, and 10 feet for pipe 6 inches in diameter and larger.
5. All piping suspended from pipe hangers shall be braced as required to eliminate sway in any direction. The rigidity of all suspended piping is subject to the approval of OWNER's representative.
6. Bolts, nuts and straps where shown or required for pipe support fasteners shall be of galvanized steel. All anchor bolts and nuts and other fasteners furnished for connection of the pipe supports to concrete structures shall be of Type 304 stainless steel. Anchorage items shall conform to the applicable requirements of Section 05505.
7. Pipe stanchion saddle supports shall be of cast iron, with adjustable construction.

3.3 TESTING OF PRESSURE PIPING

A. General:

1. Test all piping as specified below unless otherwise authorized by ENGINEER.
2. Notify 48 hours in advance of testing.
3. Provide all testing apparatus including pumps, hoses, gages, and fittings.

4. Pipelines shall hold the specified test pressure for a period of two hours.
5. Pipelines which fail to hold specified test pressures or which exceed the allowable leakage rate shall be repaired and tested.
6. Test pressures required are at the lowest elevation of the pipeline section being tested, unless otherwise specified.
7. Unless otherwise approved, conduct all tests in the presence of CONTRACTOR. Repeat tests in the presence of local authorities having jurisdiction if required by them.

B. Schedule of Pipeline Tests:

1. All piping shall be tested at 50 psig with water for a two (2) hour period.

C. Pressure Test Procedure:

1. Insure that all supports and restraint protection are securely in place.
2. Fill section to be tested slowly with water and expel all air. Install cocks, if necessary, to ensure removal of air.
3. Test only one section of pipe at a time.
4. Apply test pressure required for two hours and observe pressure gage. Check carefully for leaks while test pressure is being maintained.

D. Leakage Test Procedure:

1. Conduct leakage test for all liquid piping after satisfactory completion of pressure test.
2. Maintain test pressure constantly for a 2-hour period and accurately measure the amount of water which must be added to maintain the test pressure.
3. Allowable Leakage Rates (in gallons per hour per 1,000 feet per inch diameter):
 - a. Ductile Iron Pipe: 0.075.
 - b. Copper, Plastic, and All Other Piping: No leakage permitted.

Piping Schedule

Groundwater Pretreatment System:

Location	Size (in.)	Material	Type
Caustic Transfer System	1/2	CPVC	Socket-weld/threaded
Acid Transfer System	1/2	PVDF	Socket-weld/threaded
Compressed Air Supply Header	1	Steel	Threaded
Groundwater Transfer Piping	2 to 8	Steel	Flanged, 125#
Backwash Transfer Piping	4 to 6	Steel	Flanged, 125#
Final Effluent (Buried)	6	Ductile Iron	Mechanical Joint

END OF SECTION 15090

SECTION 15095
VALVES AND SPECIALS 4 INCHES IN DIAMETER AND LARGER

PART 1 GENERAL

1.1 SCHEDULE INCLUDES

- A. Furnish and install valves and specials for the large diameter piping systems 4 Inches in Diameter and Larger.

1.2 QUALITY ASSURANCE

- A. Reference Standards: CONTRACTOR shall comply with applicable provisions and recommendations of the standards listed hereinafter under Article 2.1.

PART 2 PRODUCTS

2.1 MATERIALS

A. Butterfly Valves:

1. Type: Manual.
2. Bodies: Short laying length type with flanged ends conforming to ANSI B16.1, Class 125. They shall be PVC with integrally hubs for shaft bearings.
3. Discs: PVC.
4. Shafts: Stainless steel, securely attached to the valve disc. Diameter of the valve shafts and the connections to the valve disc shall be suitable for the service conditions specified.
5. Seats: Teflon-lined gasket mounted in the valve body or on the disk and together with the mating-seat surface and mechanism shall be designed to provide tight shutoff at differential pressures as stated herein. Mating seats shall be Type 316 stainless steel.
6. Shaft Bearings: Self-lubricating woven teflon sleeve type. Thrust bearings shall keep the disc centered regardless of valve position.
7. Shaft Seals: Standard split-V type packing, standard "O" ring sealed or pull-down packing gland, complying with the requirements of AWWA C504.

B. Check Valves:

1. Body PVC: Flanged.
2. Seal: Viton.
3. Spring: Stainless steel.
4. Plate: PVC.

2.2 MANUFACTURERS

A. Butterfly Valves:

1. Henry Pratt Company.
2. Or equal.

PART 3 EXECUTION

3.1 VALVES AND SPECIALS

- A. CONTRACTOR shall install all valves and specials in a neat and workmanlike manner. Heavy units shall be handled by mechanical equipment. Valves or specials which are inadvertently dropped or otherwise damaged prior to OWNER's representative's final certificate shall be checked by a representative of the manufacturer and replaced or repaired, if required, at CONTRACTOR's expense.

END OF SECTION 15095

**SECTION 15120
GAS PIPING SYSTEM**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install a complete and workable system of natural gas piping including all piping, valves, regulators, metering equipment and accessories.
- B. Work Installed but Furnished by Others:
 - 1. Coordinate piping, meter and regulator requirements with the local gas utility company. Furnish and install piping, meter rig including regulators, shut-off cocks, meter bars as required by the utility company.

1.2 RELATED SECTIONS

- 1. Section 15051, Wall Pipes and Sleeves.
- 2. Section 15140, Pipe Hangers Supports and Restraints.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
 - a. Rhode Island State Uniform Fire Prevention and Building Code.
 - 2. Permits: SUB-CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified:
 - 1. ANSI A13.1, Identification of Piping Systems.
 - 2. ANSI B16.3, Malleable-iron Screwed Fittings, 150 and 300 pound.
 - 3. ANSI B16.9, Factory Made Wrought Steel Buttwelding Fittings.

4. ANSI B16.22, Wrought Copper and Bronze Solder-Joint Pressure Fittings.
5. ANSI B125.2, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Pipe for Ordinary Uses, (ASTM A 120).
6. ANSI H23.1, Seamless Copper Water Tube, (ASTM B 88).
7. ASTM B 32, Solder Metal.
8. FS O-F-506B, Flux, Soldering: Past and Liquid.
9. FS WW-U-531C, Unions, Pipe; Steel or Malleable Iron; Threaded Connection.
10. FS WW-U-516, Unions, Brass or Bronze; 250 pound.
11. ANSI Z223.1, National Fuel Gas Code (NFPA No. 54).
12. ANSI B36.10 Welded and Seamless Wrought Steel Pipe.
13. ANSI B2.1 Pipe Threads (except Dryseal).

C. Welder Qualification:

1. Provide welding performed by welders qualified to perform welding in accordance with ANSI B31.1, Paragraph 127.5 and AWS standards for ship and project site welding of piping work. Submit proof of qualifications.
2. Perform welding in accordance with procedures in ANSI B31.1, Paragraph 127.5.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturers literature, specifications and engineering data including, dimensions, size and material of the following:
 - A. Pipe and Fittings.
 - B. Valves.
 - C. Regulators.

D. Meters.

2. Drawings on a 1/4-inch scale showing materials and dimensions of the complete piping system, in plan and in section.

B. Record Drawings: During progress of the Work, keep an up to date set of drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit cloth or mylar tracings showing the actual in-place installation of all piping and equipment installed under this Section, at a scale satisfactory to OWNER. The Drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete "record" drawings of the piping systems. Two paper prints shall also be furnished. The tracings shall be furnished not later than 30 days after completion of the Contract and prior to final payment.

1.5 JOB CONDITIONS

A. Protection: Properly plug or cap the open ends of all pipe at the end of each days work or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Pipe:

1. Pipe:

a. Reference: ANSI B125.2 and ANSI B36.10

b. Weight: Schedule 40 and Schedule 80.

c. Finish:

1) Schedule 40: Black.

2) Schedule 80: Coated with coal tar primer, 2 coats of pipe line enamel, tar impregnated felt wrapper and Kraft paper with protective clear polyethylene envelope cover.

d. End Connections:

- 1) Schedule 40: Threaded (ANSI B2.1)
 - 2) Schedule 80: Welded end (API 1104, ASME Section IX Boiler and Pressure Vessel Code).
2. Fittings:
- a. Threaded:
 - 1) Reference: ANSI B16.33, 50 pound.
 - 2) Material: Malleable iron.
 - 3) Finish: Black.
3. Unions:
- a. Threaded: Malleable iron, FS WW-U-531, Class 1, Type B.
4. Joint Compound:
- a. Material: Resistant to the action of liquified petroleum gas or natural gas.
5. Insulating couplings, Dresser, a steel body with gaskets and retainer cups.
6. Coatings: Factory or manually applied as follows:
- a. Primer: Coal tar, 1.3 mil coat.
 - 1) Manufacturer: Provide products of one of the following:
 - a) Koppers, Bitumastic 70-B Hi-melt, CE grade enamel.
 - b) Reilly, "Kaiser" Hot Service Enamel.
 - c) Or equal.
- B. Lubricated Plug Valves:
1. Manufacturer: Provide products of one of the following:
 - a. Walworth Company

- b. Rockwell International Company, Nordstrom Valve Division.
 - c. Or equal.
 - 2. Type: Short pattern, wrench operated.
 - 3. Pressure rating: 175 lb wog - 350 lb test.
 - 4. End connections: Threaded.
 - 5. Construction: Cast iron body and plug with steel trim.
 - 6. Sealant: Suitable for gas application.
 - 7. Wrench: To suit valve.
- C. Lubricated Stop Cocks (1/2"-2"):
- 1. Manufacturer: Provide products of one of the following:
 - a. Eclipse Fuel Engineering Company.
 - b. A.Y. McDonald Manufacturing Company.
 - 2. Type: Flat head.
 - 3. Pressure rating: 125 lb wog.
 - 4. End Connections: Threaded
 - 5. Construction: Iron body, bronze plug.
- D. Natural Gas Pressure Regulator:
- 1. Manufacturer: Provide products of one of the following:
 - a. Rockwell International
 - b. Robert Shaw Controls.
 - c. Or equal.

2. Type: Service for outside installation.
3. Pressure rating: Maximum inlet pressure 125 psi.
4. Outlet pressure range: 8-inches water column.
5. Capacity in scfh: 600 scfh.

E. Dielectric Couplings:

1. Manufacturer: Provide products of one of the following:
 - a. Epco Sales Incorporated.
 - b. Watts Regulator Company.
 - c. Or equal.
- 2 Type: Union.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of piping shall be in accordance with Section 15090.
- B. Unions shall be provided for all screwed piping at connections to equipment and at convenient locations to permit disassembly of piping.
- C. All connections between ferrous and non-ferrous piping materials shall be made with dielectric couplings.
- D. Wherever changes in sizes of piping occur, changes shall be made with reducing fittings. The use of bushings is not permitted unless otherwise shown.
- E. All pipes passing through ceilings and walls in finished rooms shall have escutcheon plates.
- F. All underground piping shall be coated with 2 coats of coal tar enamel.
- G. All underground service piping shall be installed with a minimum cover of 2 foot-6 inches.

- H. All joints are to be welded except that "Dresser" type connections shall be used at drip pots and valves. Provide an 8 gauge, copper, bonding wire brazed to pipe on both sides of the "Dresser" fitting.
- I. Gas service lines shall pitch away from building, where possible. If they are pitched toward the building they shall be provided with drip leg and plugged outlet or drip pot as required.
- J. All gas piping in building shall be straight, free from traps and unnecessary bends and conform to building construction. Piping shall be graded 1-inch in 40 feet to provided for drainage of moisture, by 12-inch drip legs in accessible locations at low points of system. Branch connections to mains shall be from top of main or at a 45° angle.
- K. All underground piping exposed joints, fittings and damages or defective coatings shall be repaired or covered as follows:
 - 1. Kraft paper outer wrap, where present, shall be removed at least six inches from the area to be coated.
 - 2. All charred and damaged coating shall be cut away by means of a drawknife, machete or other approved means, enough coating shall be cut away so as to expose grey, unruined metal and to leave a beveled coating edge around the pipe.
 - 3. All exposed metal surfaces shall be cleaned by machine wire brush. For pipe not mill coated with coal tar, abrade the mill coating to be overlapped using sandpaper or a wire brush and remove all mill coating adhesive from the surface to be coated. Wash entire surface to be coated with cleaning solvent (or detergent) and wipe dry with clean cloths.
 - 4. Prime the bare metal and four inches of adjacent mill coating. Allow the primer to thoroughly dry before the enamel is applied.
 - 5. Strips of felt shall be cut long enough to go around the pipe and overlap it by 4 to 6 inches. Using the felt strips as slings, enamel shall be poured onto the surface of the pipe and felt, and spread to at least 1/32-inch thickness over the area to be coated by the "Ragging Method." The felt sling shall be discarded after the first coat of enamel.
 - 6. The enamel shall be inspected for voids, thin spots, sags, wrinkles and other defects. Defects shall be corrected before the application of the second coat.

7. A second coat of enamel, at least 1/32-inch thick shall be applied over the first coat using new strips of felt. The second enamel coat with a felt wrapper shall extend over the area using coated and overlap previously applied mill coatings by at least four inches.
8. Excess enamel shall be evident along all felt edges to get good sealing properties.
9. The inside page of all felt strips shall be sealed with enamel to keep out moisture.
10. The field coating shall be inspected by the coating applicator with an approved holiday detector with a peak voltage of 12,000 to 15,000 volts.

3.2 MATERIAL SCHEDULE

- A. All exposed gas piping within the interior of a building or run within a chase or shaft shall be Schedule 40 black steel.
- B. All gas service piping located under ground shall be in accordance with the requirements of the gas service company or as a minimum welded Schedule 80 black steel pipe with coating and paper mill wrap and polyethylene envelope protective cover.

3.3 FIELD QUALITY CONTROL

- A. Tests: Pressure test all systems in conformance with Section 15090.

END OF SECTION 15120

SECTION 15140
PIPE HANGERS, SUPPORTS AND RESTRAINTS

PART 1 DESCRIPTION

1.1 SECTION INCLUDES

- A. Furnish an acceptable system of support, guidance and anchorage for all piping, valves and specials.

1.2 COORDINATION

- A. Review installation procedures under other appropriate Sections and coordinate the Work that must be installed with or attached to the hangers and supports.
- B. Coordinate the location and placement of any concrete inserts, and any cutting or drilling of structural members required.
- C. Coordinate installation of the new structural piping supports as required with the existing structures, equipment and supports. The CONTRACTOR shall be responsible for cutting, re-welding or other modifications required to install and position such supports satisfactorily.

1.3 RELATED SECTIONS

- 1. Section 09900, Painting.
- 2. Division 15, Sections on Piping, Valves and Specials.

1.4 QUALITY ASSURANCE

- A. General: The manufacturer shall conform to the following general criteria:
 - 1. Materials and systems using stock or production parts shall be utilized unless otherwise shown or approved.
 - 2. Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment concentration.
 - 3. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and

prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

4. Hangers shall be installed so that they cannot become disengaged by movements of the supported pipe.
5. Conform to the recommendations of MSS-SP-58 and 69 except where requirements of this Section 15C7 are more stringent.

B. Source Quality Control:

1. Obtain each type of pipe hanger or support from no more than one manufacturer.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified:

1. The Manufacturers Standardization Society of the Valve and Fittings Industry:
 - a. MSS SP-58, Pipe Hangers and Supports - Materials and Design.
 - b. MSS SP-69, Pipe Hangers and Supports - Selection and Application.
2. FS WW-H-171, Hangers and Supports, Pipe.
3. Underwriters' Laboratories, Inc., Standard UL-203-Pipe Hanger Equipment.
4. ANSI B1.1, Unified Inch Screw Threads.
5. ANSI B31, Codes for Pressure Piping.
6. ASTM A 36, Structural Steel.
7. ASTM A 47, Malleable Iron Castings.
8. ASTM A 276, stainless and Heat-Resisting Steel Bars and Shapes.
9. ASTM A 307, Carbon Steel Externally Threaded Standard Fasteners.
10. ASTM A 320, Alloy-Steel Bolting Materials for Low-Temperature Steel.
11. ASTM A 575, M-Grades Merchant Quality Hot-Rolled Carbon Steel Bars.

12. ASTM A 666, Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications.
13. ASTM A 668, Carbon and Alloy Steel Forgings for General Industrial Use.

1.5 SUBMITTALS

- A. Shop Drawings: Submit for approval Shop Drawings showing the following:
 1. All hangers and supports for piping system specified.
 2. Location, installation, material, loads or forces, and deflection of all hangers and supports.
 3. Manufacturers' catalogs, literature, and engineering data on all hangers and supports.
 4. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP-58 and MSS SP-69.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: All materials shall be inspected for size, quality, and quantity against approved Shop Drawings.
- B. Storage of Materials: All materials shall be packaged, labeled, and stored in a covered dry location until time of installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Unless otherwise noted or shown, the CONTRACTOR is responsible for designing and supplying supports for all piping systems.
- B. The hangers and supports shall meet with the following requirements:
 1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
 2. Run piping in groups and parallel to building walls where practicable. Provide minimum clearance of one inch between pipe and other work.

3. Install hangers or supports at all locations where piping changes direction. Horizontal valves 6-inches and larger shall be supported by a hanger on each side of valve.
4. All hangers and supports shall be capable of adjustment after placement of piping.
5. Types of hangers or supports shall be kept to a minimum.
6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
7. Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration.
8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
9. Prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated, or stainless steel hangers or supports.
10. Hangers and supports shall provide for expansion throughout the full operating temperature range.
11. All plastic piping shall be supported by plastic coated steel pipe attachments.
12. Vertical struts and horizontal members shall be of a size suitable for the service intended and be compatible with frame inserts as specified in Section 5E3, Miscellaneous Metal Fabrications.

2.2 HANGERS AND SUPPORTS

A. Components of hangers and supports shall conform to the following where applicable:

1. Materials:
 - a. Bolts: ASTM A 307, Grade A, unless otherwise specified below.
 - b. Anchor and Expansions Bolts: Type 316 stainless steel, including nuts and washers.
 - c. Forgings: ASTM A 235.

- d. Malleable Iron: ASTM A 47.
 - e. Rods and Bars: ASTM A 107.
 - f. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1. 9.
Structural Steel: ASTM A 36.
2. Finish:
- a. Steel Items: Galvanized unless otherwise specified or shown on the Drawings.
 - b. All plastic piping shall be supported by plastic coated (PVC) steel pipe attachments.
- B. Pipe Attachments: The following types of pipe attachments are acceptable:
- 1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
 - 2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
 - 3. Riser Clamp: FS WW-H-171E, Type 8.
 - 4. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
 - 5. Adjustable Pipe Saddle Support: FS WW-H-171E, Type 39.
 - 6. Adjustable Pipe Roll and Base: FS WW-H-171E, Type 47.
 - 7. Insulation Protection Shield: FS WW-H-171E, Type 41.
 - 8. Insulation Protection Saddle: FS WW-H-171E, Type 40A and 40B.
 - 9. Adjustable Roller Hanger: FS WW-H-171E, Type 44.
 - 10. Pipe Slide Assembly:
 - a. Material: Carbon steel tee with stainless steel slide plate; carbon steel base with filled teflon pad.
 - b. Type: Suitable for field welding to steel pipe. Modify with clamps and U-bolts for use with ductile iron pipe.

c. Product and Manufacturer:

- 1) ITT Grinnell, Figure 257, Type 3.
- 2) Piping Specialties, Incorporated.

C. Structural Attachments: The following types of structural attachments are acceptable:

1. Welded Steel Bracket: FS WW-H-171E, Type 33.
2. Side Beam Bracket: FS WW-H-171E, Type 35.
3. Malleable Concrete Insert: FS WW-H-171E, Type 18.
4. Center I-Beam Clamp with Eye Nut: FS WW-H-171E, Type 28.

D. Hanger Rod Attachments: Use as required to complete assembly:

1. Forged Steel Clevis: FS WW-H-171E, Type 14.
2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
3. Forged Steel Weldless Eye Nut: FS WW-H-171E, Type 17.

E. Anchorage Items: All anchor or expansion bolts, nuts and washers for anchoring pipe hangers and supports shall be Type 316 stainless steel where stainless steel piping is installed and Type 304 stainless steel in all other locations.

F. All other hangers and supports shall be in accordance with MSS SP-58.

G. Product and Manufacturer: Provide hangers and supports as manufactured by one of the following:

1. ITT Grinnell Company.
2. Elcen Metal Products Company.
3. Or equal.

2.3 SURFACE PREPARATION AND PAINTING

- A. All pipe supports except stainless steel and plastic coated steel for all piping listed in the Schedule to be painted shall be prepared and painted in accordance with the requirements of Section 09900, Painting.

PART 3 EXECUTION

3.1 GENERAL

- A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.
- B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.
- C. Install hangers or supports at all locations where piping changes direction.
- D. Locate hangers and supports to prevent vibration or swaying and to provide for expansion and contraction.
- E. Hangers rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
- F. Install items to be embedded before concrete placement.
- G. Fasten embedded items securely to prevent movement during concrete placement.
- H. Hanger and support units installations methods shall be in accordance with manufacturer's recommendations.
- I. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations. Grout shall be as specified in Section 3K, Concrete.
- J. Prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated, or stainless steel hangers or supports.

3.2 INSTALLATION

- A. Supports and Hangers for Horizontal Pipes:
 - 1. Space supports and hangers for all piping no farther apart than shown below unless otherwise noted:

a. Copper Tube:

- 1) Pipes up to 2-inch: 6 feet-0 inch center to center.
- 2) Pipes 2-1/2-inch and larger: 8 feet-0 inch center to center.

b. Steel, Ductile Iron and Stainless Steel Pipe:

- 1) Pipes up to 1-inch: 6 feet-0 inch center to center.
- 2) Pipes 1-1/2-inch to 6-inch: 8 feet-0 inch center to center.
- 3) Pipes 8-inches and larger: 10 feet-0 inch center to center.
- 4) In addition, ductile iron pipe shall have a minimum of two supports per length and shall have a hanger or support adjacent to each hub.

c. Plastic Pipe:

- 1) Maximum support spacing for plastic pipe at ambient temperature shall be one-half the above values for steel pipe except that support spacing shall not exceed 4 foot-0 inches.
2. Additional supports shall be placed immediately adjacent to any change in piping direction, and on both sides of valves, expansion joints, and couplings.
3. Hanger Rods shall be sized for maximum pipe loads and according to the schedule herein for minimum rod diameters:

Nominal Pipe (Inches)	Minimum Rod Diameter (Inches)
1/2 through 3	1/2
4 through 5	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

4. Hangers and supports for pipe 3-inch diameter and larger shall be adjustable.

B. Supports for Vertical Piping:

1. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve.
2. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
3. Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration.
4. Vertical plastic piping riser clamps shall be PVC coated.

C. Expansion Anchors:

1. Use to fasten all base supports to floors.
2. Use at hangers and brackets to support piping 1-inch diameter and smaller and only if the anchor is designed to carry 200 percent of the load.

3.3 ACCEPTANCE AND SERVICE

- A. Acceptance: All pipe systems shall be brought up to operating pressures and temperatures. Systems shall be cycled to duplicate operating conditions. All malfunctions shall be corrected. The CONTRACTOR shall furnish all labor and materials to readjust and correct faults with hangers and supports for the piping systems.

END OF SECTION 15140

SECTION 15141
SVE SYSTEM SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

- A. Section 15060 - Piping and Appurtenances.
- B. Section 15260 - Piping Insulation.

1.3 REFERENCES

- A. ASME B31.1 - Power Piping
- B. ASME B31.9 - Building Services Piping
- C. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- D. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- E. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- F. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacities (vertical, horizontal, axial) of pipe support posts, channel/strap systems and hangers for single and multiple pipe gang runs and risers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable local building code for support of plumbing piping.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. VES Piping - Groundwater and Vapor.
 - 1. Conform to ASME B31.9.
 - 2. Ground Support for 2 Inch Groundwater Discharge Piping: Steel channel adjustable system with compatible hardware and pipe straps. Channels fastened to pre-cast concrete bases horizontally secured as shown on the Contract Drawings.
 - 3. Wall Support for 2 Inch Groundwater Discharge Piping: Steel channel adjustable system with compatible hardware and pipe straps. Channels fastened to existing masonry wall with masonry anchor bolt system as shown on the Contract Drawings.
 - 4. Ground Support for 4" x 1" coaxial extraction well piping: Steel channel adjustable system with compatible hardware and pipe straps. Channels fastened to vertical steel channel drive posts, pressure driven through existing pavement into earth to minimum depth, as shown on the Contract Drawings.
 - 5. Ceiling, Wall, and Floor support for VES trailer groundwater and vapor phase piping: Utilize one or more applicable methods specified A.1 through 4 above and the following:
 - a. Hangers and floor support for Pipe Sizes 1/2 to 2 Inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

- b. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- c. Vertical Support: Steel riser clamp.
- d. Floor Support for Pipe Sizes 4-6 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- e. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

- A. Inserts: Malleable iron case of [galvanized] steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods or epoxy anchor system meeting or exceeding shear and pull out strength requirements.

2.4 FLASHING

- A. Metal Flashing: 26 gage (0.5 mm thick) galvanized steel.
- B. Metal Counterflashing: 22 gage (0.8 mm thick) galvanized steel.
- C. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.5 SLEEVES

- A. Sleeves for Pipes Through Walls: Steel pipe or 18 gage (1.2 mm thick) galvanized steel with water stop.
- B. Sealant: Silicone.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and or Contractor's submitted methods which have been approved by the Contracting Officer.

3.2 INSERTS

- A. Provide inserts for suspending hangers from masonry walls, reinforced concrete slabs and sides of reinforced concrete beams.
- B. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- C. Place hangers within 12 inches (300 mm) of each horizontal elbow or as otherwise shown on the Contract Drawings.
- D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
- E. Where several pipes can be installed in parallel and at same elevation, provide multiple or gang style channel hangers, Uni-Strut, or equal.
- F. Support riser piping independently of connected horizontal piping.
- G. Provide sheet lead packing between hanger or support and piping or as otherwise recommended by the hanger/pipe support manufacturer.
- H. Design hangers for pipe movement without disengagement of supported pipe.
- I. Prime coat exposed steel hangers and supports.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

- B. Construct supports of steel pipe and fittings. Brace and fasten with flanges or plates bolted to structure.
- C. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

3.6 SLEEVES

- A. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.

3.7 SCHEDULES

- A. As shown below, or otherwise as indicated by the Contract Drawings.

PIPE SIZE Inches (mm)	MAX. HANGER SPACING Feet (m)	HANGER ROD DIAMETER Inches (mm)
1/2 to 1-1/4 (12 to 32)	6.5 (2)	3/8 (9)
1-1/2 to 2 (38 to 50)	10 (3)	3/8 (9)
2-1/2 to 3 (62 to 75)	10 (3)	1/2 (13)
4 to 6 (100 to 150)	10 (3)	5/8 (15)
8 to 12 (200 to 300)	14 (4.25)	7/8 (22)

END OF SECTION 15141

SECTION 15260
PIPING INSULATION

1 PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all required piping insulation, jackets and accessories.

1.2 RELATED SECTIONS

- A. Section 15060 - SVE Piping and Appurtenances.

1.3 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded - Hot-Plate Apparatus.
- C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- E. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- F. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- G. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- H. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- I. ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
- J. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- K. ASTM E84 - Surface Burning Characteristics of Building Materials.
- L. ASTM E96 - Water Vapor Transmission of Materials.

M. NFPA 255 - Surface Burning Characteristics of Building Materials.

N. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Samples: Submit 2 samples of any representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84.

1.6 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum 3 years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01610.

B. Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

2 PART 2 PRODUCTS

2.1 POLYETHYLENE

- A. Insulation: ASTM D1056 or D1667; flexible, closed cell, polyethylene, slit tubing.
 - 1. 'K' ('ksi') Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
 - 2. Minimum Service Temperature: -90 degrees F (-67 degrees C).
 - 3. Maximum Service Temperature: 212 degrees F (100 degrees C).
 - 4. Density: ASTM 1667; 2 lb/cu ft (32 kg/cu m).
 - 5. Maximum Moisture Absorbtion: 1.0 percent by volume.
 - 6. Moisture Vapor Transmission: ASTM E96; 0.01 perm inches.
 - 7. Maximum Flame Spread: ASTM E84; 25.
 - 8. Maximum Smoke Developed: ASTM E84; 50.
 - 9. Connection: Contact adhesive.

2.2 JACKETS

- A. Aluminum Jacket: ASTM B209.
 - 1. Thickness: 0.020 inch (0.50 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.02 inch (0.5 mm) thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

3 PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On all exposed piping for liquid and vapor transmission:
 - 1. Locate insulation and cover seams in least visible locations.
 - 2. Size large enough to enclose pipe and heat tracer.
 - 3. Provide vapor barrier jackets, factory applied or field applied.
 - 4. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 - 5. Finish with glass cloth and vapor barrier adhesive.

6. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
7. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, [pump bodies,] and expansion joints.

C. Inserts and Shields:

1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: ASTM C640 cork or other heavy density insulating material suitable for the planned temperature range.

D. Finish insulation at supports, protrusions, and interruptions.

E. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

F. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 POLYETHYLENE INSULATION SCHEDULE

	PIPING SYSTEMS	PIPE SIZE	THICKNESS
		Inch	Inch
A.	Coaxial Extraction Well Piping	4	1
B.	SVE Groundwater Forcemain	2	1
C.	Groundwater Forcemian	4	1

END OF SECTION 15260

SECTION 15335
DRY PIPE SPRINKLER SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide a complete and workable system of automatic dry-pipe sprinklers including all piping, sprinkler heads, alarms and accessories as specified and to the limits shown.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
 - a. State of Rhode Island Basic Building Code.
 - b. Cranston Rhode Island Fire Department.
 - c. NFPA Standard No. 13. Sprinkler Systems.
 - d. NFPA Standard No. 24.
 - e. Permits: CONTRACTOR shall obtain and pay for all required permits, fees, inspections and approvals by authorities having jurisdiction.
- B. All piping and fittings shall be Factory Mutual or Underwriters Laboratories approved. All equipment used shall be Factory Mutual or Underwriters Laboratories listed and/or labeled.
- C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified:
 - 1. ASTM A 47, Malleable Iron Castings Grade 32510.
 - 2. ASTM A 48, Gray Iron Castings.
 - 3. ASTM A 53, Welded and Seamless Steel Pipe.

4. ASTM A 120, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses.
5. ASTM A 183, Heat-Treated Carbon Steel Track Bolts and Carbon Steel Nuts.
6. ASTM A 126, Gray Iron Castings for Valves, Flanges and Pipe Fittings.
7. ASTM A 234, Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
8. ASTM A 307, Carbon Steel Externally and Internally Threaded Fasteners.
9. ASTM A 449, Quenched and Tempered Steel Bolts and Studs.
10. ASTM B 5, Electrolytic Copper Wire Bars, Cakes, Slabs, Billets, Ingots and Ingot bards.
11. ASTM B 19, Cartridge Brass Sheet Strip, Plate, Bar and Disks.
12. ASTM B 584, Copper Alloy Sand Castings for General Applications.
13. ASTM D 1330, Sheet Rubber Gaskets.
14. ASTM D 2000, Elastomeric Materials for Automotive Applications.
15. ANSI A21.10, Gray-Iron and Ductile Iron Fittings.
16. ANSI A21.11, Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.
17. ANSI A21.15, Flanged Cast Iron and Ductile Iron Pipe with Threaded Flanges.
18. ANSI A21.51, Ductile Iron Pipe Centrifugally Cast.
19. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
20. ANSI B16.3, Malleable Iron Screwed Fittings, 150 and 300 lb.
21. ANSI B16.4, Cast Iron Screwed Fittings, 125 and 250 lb.
22. ANSI B16.5, Steel Pipe Flanges, Flanged Valves and Fittings.

23. ANSI B16.9, Factory-Made Wrought Steel Butt weld Fittings.
24. ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded.
25. ANSI B16.25, Buttwelding Ends.
26. ANSI B2.1, Pipe Threads.
27. ANSI B31.1, Power Piping.
28. ANSI B36.10, Welded and Seamless Wrought Steel Pipe.
29. CDA 411, Brass.
30. AWWA C703, Cold Water Meters-Fire Service Type.
31. NFPA Standard No. 13, Standard for the Installation of Sprinkler Systems.
32. NFPA Standard No. 24, Standard for Outside Protection.

D. Field Measurements: Take field measurements where required prior to preparation of Shop Drawings and fabrication to ensure proper fitting of work.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval, the following:

1. Manufacturers literature, specifications, and engineering data including dimensions, size, weights and materials for the following:
 - a. Pipe and fittings.
 - b. Unions.
 - c. Flexible couplings.
 - d. Valves.
 - e. Sprinkler heads.
 - f. Sprinkler cabinet.
 - g. Hangers and supports.

- h. Escutcheons.
 - i. Pipe labels.
 - j. Other materials and equipment requested by ENGINEER.
- 2. CONTRACTOR shall prepare a complete set of plans, Specifications and calculations as required for obtaining approval by the local building and fire departments.
 - 3. Detailed 1/4 inch scale drawings showing materials and dimensions of the complete automatic sprinkler system.
- B. Record Drawings: During progress of the Work, keep an up to date set of drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit cloth or mylar tracing showing the actual in place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The Drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete "record" Drawings of the piping systems. Two paper prints shall also be furnished. The tracings shall be furnished not later than 30 days after completion of the Contract and prior to final payment.

1.4 JOB CONDITIONS

- A. Protection: Properly plug or cap the open ends of all pipe at the end of each days work or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical damaged.
- B. Existing Conditions:

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Pipe:
 - 1. Pipe:
 - a. Reference: ASTM A 120.
 - b. Weight: Schedule 40.

- c. Finish: Black.
- 2. Fittings:
 - a. Threaded: ANSI B2.1.
 - 1) Reference: ANSI B16.3, 150 lb.
 - 2) Material: Malleable Iron.
 - 3) Finish: Black.
 - 4) Rating: 175 lbs. WOG.
- 3. Unions:
 - a. Threaded: Malleable Iron, FS WW-U-531, Class 1, Type B. 1-1/2 inch pipe size and smaller only.
- 4. Thread Tape:
 - a. Material: Teflon.
 - b. Underwriters laboratory or Factory Mutual approved.
- 5. Flexible Couplings:
 - a. Manufacturers: Provide couplings made by one of the following:
 - 1) Victaulic Company of America.
 - 2) Aeroquip Corporation, Gustin Bacon Division.
 - b. Material: Malleable from ASTM A 47.
 - c. Finish: Red.
 - d. Nuts and Bolts: Carbon steel ASTM A 449 and ASTM A 183.
 - e. Gasket: EPDM, ASTM D 2000.

2.2. EQUIPMENT

A. Bronze Body Gate Valves:

1. Manufacturers: Provide one of the following:
 - a. Jenkins Brothers Corporation Fig. 275-U.
 - b. Walworth Company Fig. No. 873.
 - c. Or equal.
2. Type: Outside screw and yoke, rising stem solid wedge disc.
3. Materials: Brass and Bronze
4. Rating: 175 lb. WOG.
5. End Connections: Threaded.
6. Markings: UL, FM, rating and manufacturers markings cast on body.

B. Steel Body Gate Valves:

1. Manufacturer: Provide one of the following:
 - a. Mueller Co. A-2052-6
 - b. Or equal.
2. Type: Non-Rising stem post indicator flange
3. Materials: Iron Body
4. Rating: 175 PSI working pressure
5. End Connections: 125 lb. flanged ANSI B16.1
6. Markings: UL, FM Rating
7. Size: 4 inch to 14 inch pipe size

C. Steel Wafer-Body Butterfly Valve:

1. Manufacturer: Provide one of the following:
 - a. Mueller Co. B-3250-00
 - b. Or equal.
2. Type: Gear Operated Butterfly
3. Materials: Steel
4. Rating 175 lb working pressure
5. End connections wafer body fits between ANSI B16.5, Class 150 flanges
6. Markings: UL, FM Rating
7. Size: 2-1/2 inch to 8 inch pipe size
8. Accessories: No switch required

D. Steel Body Gate Valve:

1. Manufacturer: Provide one of the following:
 - a. Mueller Co. A-2078-6
 - b. Or equal.
2. Type: OS&Y
3. Materials: Iron Body
4. Rating: 200 PSI working pressure
5. End Connections: 125 lb flanged ANSI B16.1
6. Markings: UL, FM Rating
7. Size: 4 inch to 10 inch sizes.

E. Cast Iron Wafer Body Check Valve:

1. Manufacturer: Provide one of the following:
 - a. Mueller Co. A-2102
 - b. Or equal.
2. Type: Wafer Body
3. Materials: Cast Iron
4. Rating: 175 PSI working pressure
5. End Connection: Wafer Body fits between ASNI B16.5 Class 150 flanges.
6. Markings: UL, FM Rating
7. Sizes: 4 inch to 8 inch pipe sizes

F. Detector Check Valve

1. Manufacturer: Provide one of the following:
 - a. Mueller Co. A-2132-6
 - b. Or equal.
2. Type: Detector
3. Material: Cast Iron
4. Rating: 175 PSI working pressure
5. End Connections: 125 lb flanged ANSI B16.1
6. Markings: UL, FM Rating
7. Size: 4 inch to 10 inch pipe sizes
8. Meter: Optional

G. Dry Pipe Valve:

1. Manufacturer: Provide one of the following:
 - a. Grinnell Corp. F302 with Posi-Quick dry pipe valve accelerator F311
2. Type: Differential latch
3. Material: Cast Iron
4. Rating: 175 lb working pressure
5. End Connections: 125 flanged ANSI B16.1
6. Markings: UL1, ULC, FM, LPC & SSL Rating
7. Size: 4 inch & 6 inch pipe sizes
8. Accessories Model F311 Accelerator

H. Connections Fire Department:

1. Manufacturer: Provide one of the following:
 - a. Grinnell Model F715
 - b. Or equal.
2. Size: 2-1/2" hose x 2-1/2" hose x 4" NPT

I. Indicator Post

1. Manufacturer: Provide one of the following:
 - a. Grinnell Model F753
 - b. Or equal
2. Type: Wall mounted
3. Markings: UL1 and ULC listed FM approved

J. Check Valve

1. Manufacturer: Provide one of the following:
 - a. Grinnell model F520
 - b. Or equal
2. Type: Swing check vertical or horizontal mounting
3. End Connections: 125 lb flange ANSI B16.1
4. Size: 4 inch to 8 inch pipe sizes

K. Automatic Sprinklers, Upright

1. Manufacturer: Provide one of the following:
 - a. Grinnell Model F950 Duraspeed
 - b. Or equal.
2. Type:
 - a. Upright spray 1/2" orifice
3. Rating: 175 lb WOG.
4. Temperature Rating: 212°F.
5. Markings:
 - a. All sprinklers shall be permanently marked with the manufacturer, the model, year and temperature
6. End Connection: Threaded

L. Automatic Sprinklers, Pendent

1. Same as above
2. Type:

- a. Pendent spray 1/2" orifice
- 3. Same as above
- 4. Same as above
- 5. Same as above
- 6. Same as above
- 7. Size: 1-inch to 2 inch pipe size.

M. Sprinkler Cabinet:

- 1. Manufacturer: Provide cabinets made by one of the following:
 - a. Reliable Co.
 - b. Or equal.
- 2. Type: Sprinkler head cabinet for sprinkler head, sprinkler wrench storage.
- 3. Material: Enameled Steel.
- 4. Markings: Manufacturers name and words "AUTOMATIC SPRINKLERS, RESERVE SUPPLY" stenciled on face of cabinet.
- 5. Contents:
 - a. Two sprinkler wrenches.
 - b. 6 spare sprinkler heads of each type used in the building.

N. Hangers and Supports:

- 1. Manufacturer: Provide hangers made by one of the following:
 - a. ITT Grinnell Corporation.
 - b. Elcen Metal Products Company.
 - c. Or equal.

2. Type: clamps, hooks, rods, hangers used to support a sprinkler piping system from the structure.
3. Materials: Comply with the requirements of NFPA No. 13, Underwriters' Laboratory and Factory Mutual approved.
4. Supports and Stands: Section 5A

O. Escutcheons:

1. Manufacturers: Provide one of the following:
 - a. ITT Grinnell Corporation Figure 13.
 - b. F and S Manufacturing Company Figure 602.
 - c. Or equal.
2. Type: Split ring with set screw.
3. Material: Chrome plated cast brass.

P. Pipe Labels:

1. Type: Self-adhering, temperature resistant, waterproof, corrosion resistant.
2. Marker size, Marker color, Legend size, and Legend color shall conform to ANSI A13.1.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. The installation of the sprinkler system shall conform to the requirements of the NFPA Standard No. 13, and the supplemental Specifications below.
2. Provide all necessary supports, angle iron stands, miscellaneous steel, inserts, anchor bolts and hangers required for all equipment furnished under this Section. Supports, angle iron stands, etc., shall be in accordance with Section 5A.
3. Install all items as shown, specified, and as recommended by the manufacturer.

4. Request instructions from the ENGINEER when there is a conflict between the manufacturer's recommendations and the Drawings or Specifications.
5. Present conflicts between piping systems and equipment or structures to the ENGINEER who will determine corrective measures to be taken.
6. Do not modify structures to facilitate installation of piping unless specifically approved by the ENGINEER.
7. Defective Materials: Examine piping, fittings, valves, sprinkler heads, and accessories to be installed and reject those which are defective or in poor condition.
8. Cleaning: Thoroughly clean all piping, fittings, valves and accessories.

B. Piping:

1. Install straight runs true to line and elevation.
2. Install vertical pipe truly plumb in all directions.
3. Install piping parallel or perpendicular to building walls. Piping at odd angles and 45° runs across corners will not be accepted unless specifically shown on the Drawings.
4. Install small diameter piping generally as shown on the Drawings when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, etc.
5. Provide drains at low points of all lines and wherever sprinkler piping is trapped.
6. Install underground piping in accordance with NFPA No. 24 Chapter 9.

C. Joints:

1. General:
 - a. Make joints in accordance with the pipe manufacturer's recommendations and the supplemental specifications below.
 - b. Cut piping accurately and squarely and install without forcing or springing.

- c. Ream out all pipes and tubing to full inside diameter after cutting.
 - d. Remove all cuttings and foreign matter from the inside of pipes and tubing before installation.
- 2. Threaded Joints: Use standard, right hand tapered full depth threads on steel piping and apply an approved joint compounds to the male threads only, before installation. Leave not more than three pipe threads exposed at each connection.
 - 3. Flanged Joints: Assemble flanged joints with approved full face gaskets and gasket compounds and draw up flange bolts evenly.
 - 4. Welded Joints: ANSI B31.1 latest revision and requirements of the American Welding Society for pipe welding.
- D. Unions:
- 1. Provide a union downstream of each valve with screwed connections.
 - 2. Provide screwed or flanged unions where shown, where necessary to install piping, and so that piping may be readily dismantled in small sections.
- E. Valves and Accessories:
- 1. Provide supports for large valves, and other heavy items as shown.
 - 2. Install floor stands as shown and as recommended by the manufacturer.
 - 3. Position valve operators as shown. When the position is not shown, install the valve so that it can be conveniently operated and as approved by the ENGINEER. Avoid placing operators at odd angles to the floors or walls.
- F. Head Quantity:
- 1. Piping and sprinkler heads shown on the Drawings are for estimating purposes only. Actual quantity and locations shall be as required by the local fire protection agency (Fire Marshall's Office). CONTRACTOR shall furnish and install complete, all piping, and sprinkler heads as required to conform to all local, state, and federal laws, codes, and ordinances having jurisdiction over this project.

G. Sprinkler Head Guards:

1. Sprinkler heads which are less than 84 inches above finished floor or are so located as to be subject to injury, shall be protected with approved guards.

H. Gages:

1. An approved 3-1/2-inch diameter spring pressure gage shall be installed at each test pipe location.

I. Control Valves:

1. All section control valves shall be installed in accessible locations.

J. Test Pipes:

1. Test pipes shall be provided in accordance with NFPA Bulletin 13 and same shall discharge into the nearest open site floor drain or outside of building.

K. Signs:

1. Enameled signs with appropriate nomenclature as approved by the COR, shall be installed at each control valve, drain, inspector's test station, alarm horn, etc.

END OF SECTION 15335

SECTION 15365
PORTABLE FIRE PROTECTION EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all portable fire protection equipment work.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the portable fire extinguishers.

1.2 RELATED SECTIONS

- 1. Section 10400, Identification Devices.

1.3 QUALITY ASSURANCE

- A. Source Quality Control: Furnish portable fire protection equipment Work from one manufacturer.
- B. Requirements of Regulatory Agencies: Provide only portable fire extinguishers that are approved and labeled by UL.
- C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
 - 1. UL, Fire Classification Rating.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval copies of manufacturer's technical data, certification of UL rating, and installation instructions for all portable fire protection equipment Work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide manufacturer's standard mounting brackets for portable fire extinguishers size as specified, unless recessed cabinets are shown.

B. Multi-Purpose Dry Chemical:

1. 10 pound capacity, enameled steel container with pressure-indicating gauge, for Class A, Class B, Class C fires, UL rating 4A-60 BC.
2. Product and Manufacturer: Provide one of the following:
 - a. Cosmic Model 10E by J.L. Industries.
 - b. Model 10 TAS by Walter Kidde and Company.
 - c. Or equal.

C. Carbon Dioxide:

1. 10 pound enameled steel container capacity, for Class B and Class C fires UL rating.
2. Product and Manufacturer: Provide one of the following:
 - a. Sentinel Model 10 by J.L. Industries.
 - b. 10 KS-3 by Walter Kidde and Company.
 - c. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer must examine the substrates and conditions under which the portable fire extinguishers are to be installed, and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

- A. Install in locations and at mounting of 3 feet-0 inches. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.
- B. Wherever exact locations of units are not shown, locate as directed by ENGINEER.

- C. Install signs directly above surface mounted portable fire extinguishers, securely mounted, attached to substrate in accordance with manufacturer's instructions. Install level and plumb.
- D. Recharge and bring last inspection date up to coincide as nearly as possible with date of Final Acceptance by OWNER, to provide full term inspection interval.
- E. Inform OWNER of next required inspection and recharging date.

3.3 SCHEDULE

- A. Type A - Dry chemical, wall mounted.
- B. Type B - Carbon dioxide, wall mounted.

END OF SECTION 15365

SECTION 15400
COMPRESSED AIR EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install a complete and workable compressed air system.

1.2 RELATED SECTIONS

1. Section 05505, Anchor Bolts, Expansion Anchors and Concrete Inserts.
2. Section 13410, General Instrumentation and Control Requirements.
3. Division 15, Sections on Piping.
4. Division 16, Electrical.

1.3 QUALITY ASSURANCE

- A. Obtain all of the equipment specified herein from the supplier of the air compressors in whom responsibility for the proper function of all the units as a completely integrated system shall be vested. The CONTRACTOR shall, however, retain ultimate responsibility under this Contract for equipment coordination, installation, operation and guarantee.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Equipment layout drawings.
 2. Wiring diagrams.
 3. Piping diagrams.
 4. Manufacturer's literature, illustrations, specifications and engineering data including: weight, dimensions, materials of construction, and performance e.
- B. Operation and Maintenance: Submit complete manuals including:
1. Copies of all Shop Drawings, test results, maintenance data and schedules,

description of operation and spare parts information.

1.5 GUARANTEE

- A. Guarantee: In addition to the manufacturer's standard guarantee, CONTRACTOR shall include the services of a factory-trained technician to provide repair service for the equipment for the period of one year commencing with the time the equipment is placed in continuous permanent operation (Substantial Completion). This service shall include the cost of all replacement parts required during the interval.
- B. Warranty: The compressor units shall also be warranted by the manufacturer for a five year period from the time the equipment is placed in continuous operation (Substantial Completion). Wear items such as seals and bearings may be prorated during the five year period.

PART 2 PRODUCTS

2.1 AIR COMPRESSORS AND ACCESSORIES

A. General:

- 1. The compressed air system shall consist of one (1), lubricated rotary screw, compressor, a horizontal receiver tank which is mounted on and all accessories and appurtenances as specified herein.
- 2. Equipment required shall include, but is not limited to: one (1) 100 percent capacity, dynamically-balanced air compressor rated nominally at 200 SCFM and 125 psig; an entrainment separator complete with automatic condensate trap,, and horizontal ASME-coded air receivers for the compressors. Each receiver shall also be equipped with accessories, and they shall include automatic condensate traps, ASME-rated relief valves, pressure gages, temperature gages, service valves, and three pressure switches. Compressor control panel, prefilters for oil removal with automatic valve, one heatless regenerative-type air dryer, and one afterfilter shall be furnished. Compressors shall be furnished with vibration isolation mounts.

B. Equipment:

- 1. Filter-silencer: The suction piping to each compressor shall be equipped with a "fail-safe," dry-type paper filter element in combination with an intake silencer.
- 2. Air Compressors: Each compressor shall be equipped with a low oil level or pressure protection switch and a belt guard for the drive. Lubrication shall be of

either the pressure or splash type. Each compressor shall be equipped with a low oil level or pressure protection switch and a belt guard for the drive. Lubrication shall be of either the pressure or splash type. Each compressor shall be supplied with an energy efficient, foot-mounted, NEMA Design B, totally-enclosed, fan-cooled, squirrel-cage induction motor suitable for operation on 460 volts, 3 phase, 60 Hz. Each motor shall be of sufficient rating to drive the compressor continuously at design conditions without exceeding the nameplate rating but shall not be more than 15 horsepower. Maximum speed shall be 1800 rpm. Motors shall have a 1.15 service factor and shall be supplied with anti-friction bearings having a minimum B-10 life of 50,000 hours, as defined by AFBMA. Bearings shall be arranged for grease or oil lubrication. Motor insulation systems shall be Class F. The maximum temperature rise above ambient shall not exceed the value specified for Class B insulation systems. Motors shall be as manufactured by Reliance Electric Company, General Electric or equal.

3. Air Receivers: Receivers shall be a horizontal configuration, of welded steel construction and shall meet ASME code requirements. Receivers shall each have a minimum capacity of 120 gallons. Equipment to be mounted on each receiver shall be as specified hereinafter.
4. Pressure Switches:
 - a. Type: Bronze Bourdon tube-type with aluminum alloy case, 4-1/2-inch diameter, white face with black characters and 1/4 inch NPT connection.
 - b. Setpoint Accuracy: \pm percent of span, field adjustable over full range by external calibrated dial.
 - c. Deadband: 1 psig average.
 - d. Contacts: Snap action, SPFT rated, 5 amperes at 120 volts, 60 Hz.
 - e. Range: 0-150 psig.
 - f. Service: Receivers, three units: high low pressure switch, low, "low-low" pressure switch and "high-high" pressure switch.
5. Automatic Drain Valves:
 - a. Service: Receivers,, prefilter (oil filter).
 - b. Electrically operated, 120 volts, 60 Hz, solid state controls.

- c. Controls shall be installed in compressor control panel as specified hereinafter.
 - d. Valve: Brass construction, full port, 1/8 inch orifice with minimum drain capacity of 4 gph.
6. Pressure Gage Indicators:
- a. Service: Compressor outlet air discharge upstream of each aftercooler, connected to each air receiver, downstream of afterfilter.
 - b. Range: 0-150 psig.
 - c. Accuracy: ± 1.0 percent of scale range.
 - d. Type: Brass Bourdon tube-type, 4-1/2-inch diameter dial, aluminum alloy case.
7. Air Temperature Gage Indicators:
- a. Service: Compressor outlet air discharge temperature upstream of after cooler, connected to air receiver, upstream of air dryer.
 - b. Range: 0 to 250 F.
8. Prefilters:
- a. Prefilter (oil filter) shall be furnished with an automatic drain valve. Furnish additional prefilter ahead of oil filter. Additional unit is similar to afterfilter and will be used to prolong life of prefilter.
 - b. Type: Replaceable cartridge.
 - c. Removal: 100 percent removal of all particles 0.25 microns and larger, 99.999 percent efficiency in removal of oil aerosols.
 - d. Operating Conditions:
 - 1) Flow: 100 SCFM (minimum).
 - 2) Pressure: 100 psig.
 - e. Service: Upstream of air dryer.

9. Air Dryer:

- a. Type: Heatless regenerative type complete with switching valves, adjusting valve, purge flow indicator, ASME-coded chambers filled with dessicant and automatic controls. The unit shall have the following characteristics:
 - 1) Operating Conditions - Design Data:
 - a) Nominal Inlet Capacity: 200 SCFM.
 - b) Pressure: 125 psig.
 - c) Maximum Air Temperature: 115 F.
 - d) Dry air pressure dewpoint: -40 F.
- b. Electrical Input: 120 volts, single phase, 60 Hz, derived from compressor control panel.
- c. Electrical Enclosure: NEMA 4X.
- d. Instrumentation:
 - 1) Chamber pressure gages.
 - 2) Moisture indicator.
 - 3) Purge flow indicator.
 - 4) Switching failure contact.
 - 5) Purge economizer.

10. Afterfilter:

- a. Service: Downstream of air dryer.
- b. Removal Rating: 1.0 micron and larger.
- c. Rating: 200 SCFM at 125 psig.

11. Equipment Bypass: Equipment bypass piping shall be furnished for the following equipment:

- a. Heatless regenerative air dryer.
 - b. Afterfilter.
12. Miscellaneous Valves and Accessories: The following miscellaneous valves and accessories shall be furnished:
- a. Check Valves: Located downstream of air compressors.
 - b. Valves: Conform with units specified under Section 15080.
 - c. Flexible Connectors: Locate units between air compressors and air receivers.
 - d. Pressure Relief Valves: Locate a unit on each compressor discharge pipe and at each receiver.
13. Common Compressor Control Panel: Control panel shall conform to the applicable requirements of Section 13400. Unit shall be suitable for wall mounting and shall have the following features:
- a. NEMA 4 enclosure.
 - b. One main disconnect switch for each compressor. Deactivating the circuit breaker for one compressor shall not preclude full automatic operation of the other compressor.
 - c. A magnetic full-voltage across-the-line motor starter with 120 volt control circuit for each compressor motor. The starters shall have three thermal overload relay units of the melting alloy type. The starters shall also be provided with a normally-closed motor starter contact for control of the motor space heaters furnished with each compressor motor.
 - d. Control transformer to provide supply voltage for controls; 480/120 volts, 60 Hz, 200 VA minimum. If other voltages are required, appropriate transformers shall be installed.
 - e. Pilot lights to be transformer-type, 24 volts.
 - f. Elapsed time meter for each motor. Meter to be four or five digit, nonreset type, graduated in hours.

- g. Engraved phenolic nameplates mounted on panels below each push button, light, instrument and accessory. Nameplate location and designated shall be subject to approval of CONTRACTOR. Nameplates to have black letters on white background. Nameplates shall be attached with stainless steel screws.
- h. "Off-Auto" selector switch (each compressor).
- i. "On" indicating light (green) for each compressor.
- j. Alarm indicating lights (red) for the following conditions:
 - 1) Air compressor overload (each compressor).
 - 2) Receiver air pressure: High.
 - 3) Receiver air pressure: Low.
 - 4) Air dryer switching failure.
- k. Alarm and "On" indicators shall be of the indicator lamp-type with the following features:
 - 1) Lamps: Transformer type 24 volts, amber.
 - 2) Relays: 115 volts, 60 Hz.
 - 3) Logic: Lights, steady bright on alarm conditions.
 - 4) Reset: Normally open, momentary push button.
 - 5) Lamp Test: Normally open, momentary push button (all lamps).
- l. Dry alarm contract rated at 5 amperes, 120 volts, 60 Hz, shall be provided to represent a common alarm for the above alarm conditions. Common alarm shall connect to the Main Control Panel annunciation system.
- m. Control Sequence Operation:
 - 1) Automatic Controls:
 - a) Compressors to start unloaded.

- b) Selected compressor shall start at 80 psig and stop at 125 psig.
- c) Restart compressor when pressure drops to low limit (90 psig).
- d) If pressure drops to 70 psig, low pressure alarm shall sound and standby compressor shall start.
- e) Compressors shall alternate automatically after 24 hours of operation.
- f) If pressure exceeds 100 psig, high pressure alarm shall be actuated.

C. Product and Manufacturer: Provide equipment as manufactured by one of the following:

- 1. Air Compressors:
 - a. Ingersoll-Rand.
 - b. Or equal.
- 2. Prefilter, Afterfilter and Air Dryer.
 - a. Ingersoll-Rand
 - b. Or equal.

D. Painting:

- 1. The air compressors, air receivers and auxiliary equipment shall be furnished with the manufacturer's standard paint system.
- 2. Field painting shall be as specified under Section 09900.

PART 2 EXECUTION

3.1 INSPECTION

- A. Install equipment in accordance with the manufacturer's instructions and recommendations, and the approved Shop Drawings.
- B. Installation of piping shall be in accordance with Division 15.

- C. Stainless steel anchor bolts shall be installed in the air receiver foundation using a bolt layout template supplied by the compressor manufacturer.
- D. Installation shall include furnishing and applying an initial supply of lubricants recommended by the manufacturer.

3.2 START-UP AND FIELD TEST

- A. CONTRACTOR shall verify that the foundation, piping and equipment are compatible.
- B. Make adjustments and calibrate equipment as required to place the system in proper operating condition.
- C. A qualified representative of the manufacturer shall check and approve the installation before operation. He shall test and operate the system in the presence of the CONTRACTOR and verify that the equipment conforms to Specification requirements. A minimum of one 8-hour day shall be provided for this purpose. In the event of trouble with the equipment, he shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

3.3 TRAINING

- AS. The CONTRACTOR shall supply the services of a qualified representative of the compressor manufacturer to instruct the operating personnel in operation and maintenance of the equipment specified under this Section. A minimum of one 8-hour day shall be provided for this purpose.

END OF SECTION 15400

SECTION 15550
UNIT HEATERS - GAS FIRED

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install the gas fired unit heaters complete with accessories including room thermostat.

1.2 RELATED SECTIONS

- 1. Division 1, General Requirements.
- 2. Section 15970, Automatic Temperature Controls.
- 3. Section 15990, Testing, Adjusting and Balancing of HVAC Systems.
- 4. Section 15120 Gas Piping System.
- 5. Division 16, Electrical.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have a minimum of 5 years experience in producing substantially similar type equipment and shall show evidence of at least 5 installations in satisfactory operation.
- B. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdiction.
 - 1. National Fire Protection Association (NFPA).
 - 2. Underwriters Laboratories, Incorporated (UL).
 - 3. National Electric Code (NEC).
 - 4. National Electric Manufacturer's Association (NEMA).
 - 5. Local and State Building Codes and Ordinances.
 - a. Rhode Island State Uniform Fire Prevention and Building Code.

6. American Gas Association
- C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- D. Certification:
 1. A.G.A., American Gas Association

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 1. Manufacturer's literature, illustrations, specifications, and engineering data including the following:
 - a. Dimensions, weights.
 - b. Capacities.
 - c. Materials of Construction.
 - d. Finishes.
 2. Drawings showing fabrication methods, assembly, installation details and accessories.
- B. Operation and Maintenance Data: Submit complete manuals including:
 1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information all in conformance of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
 1. Unit heaters shall come completely assembled and protected.
 2. Suction and discharge parts shall be protected against entry of foreign objects.

B. Storage of Material:

1. Store units in a clean, dry area, out of the weather.
2. Cap all pipe connections.
3. Units shall remain in crate till time of actual installation.
4. Units shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.

C. Handle to prevent damage during installation and storage.

PART 2 PRODUCTS

2.1 DESIGN CONDITIONS

- A. Design conditions shall be as indicated on the equipment data on the Drawings.
- B. Manufacturer: ; Provide product(s) of one of the following:
1. The Trane Company, Model (GHND.
 2. Modine Manufacturing Company.
 3. Sterling Gas Fired Heating Company.
 4. Or equal.

2.2 DETAILS OF CONSTRUCTION

- A. Casing:
1. Heavy gage steel.
 2. Metal surface factory treated to prevent rust with baked enamel finish.
 3. Built in adjustable discharge louvers.
 4. High efficiency type, gas fired propeller fan unit heater.
 5. Factory installed and wired flue vent fan.
 6. Brackets with hanger holes for suspended mounting of unit.
 7. Spring hangers with housed spring isolators.

B. Burner:

1. Gas fired.
2. Material: Type 409 stainless steel.
3. Design: Non clogging, slotted ports.
4. Port protector.
5. Burner assembly shall be of unitized construction with electric power operated pilot and main gas valves, spark ignition controls.

C. Heat Exchanger:

1. Construction:
 - a. Design: Air foil contoured tubes.
 - b. Material: Corrosion resistant Type 409 stainless steel.
2. Welded construction.
3. Indirect fired.

D. Fan:

1. Propeller Type: Statically and dynamically balanced.

E. Motor:

1. Single speed.
2. Single phase.
3. Built in overload protection.
4. Factory mounted and wired.
5. Mounted with vibration isolators.
6. Totally enclosed.

F. Efficiency:

1. 80% minimum.

G. Controls:

1. Factory wired and mounted.

- a. High limit switch.
- b. Ignition transformer and spark ignition controller.
- c. Unit mounted disconnect switch.
- d. Safety shutdown, 24 volt gas valve with 100 percent safety pilot and main gas valve shutoff.
- e. Manual shut off valve on gas line.
- f. Fan controls, fan time delay switch.
- g. Gas pressure regulator.
- h. Leak limiting device.
- i. 120 V/24V transformer as required.

2. Field Installed:

- a. Low voltage room thermostat, shipped loose by gas heater manufacturer for field mounting.
- b. 24 volt AC.
- c. 56 F to 94 F temperature setting range.
- d. Fan auto-on (summer/winter) switch.

3. Sequence of Operation:

- a. Refer to Contract Drawing (Sheet H-1).

H. Draft

1. Construction: Heavy gauge steel.

I. Spring Hangers:

1. Housed Spring Mountings:

- a. Type: Spring isolator, free standing, laterally stable with housing.
- b. Efficiency: 95 percent at rated load.
- c. Construction:
 - 1) Housing: Shall include vertical limit stops.
 - 2) Clearance: Maintain 1/2-inch clearance around restraining bolts and between housing and spring.
 - 3) Baseplate with 1/4-inch acoustical friction pad between baseplate and support.
 - 4) Leveling bolts rigidly bolted to the equipment.
 - 5) Spring diameter 0.8 of the compressed spring height at rated load.
 - 6) Minimum spring deflection before becoming solid shall be at least 50 percent greater than the specified minimum deflection.
- d. Total rated capacity of isolators shall be at least 150 percent the weight of equipment supported. CONTRACTOR to verify the actual weight of the equipment to be supported.
- e. Housings, fabricated steel parts, accessories and springs for isolators to be completely neoprene coated.
- f. Manufacturers:
 - 1) Provide isolation equipment of one of the following:
 - a) Mason Industries.
 - b) Vibration Eliminator Company.

c) Or equal.

- g. Provide stainless steel hanger rods and hardware. Minimum size to be 1/2-inch diameter.

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspect units for damage prior to installation and correct if necessary as recommended by manufacturer.

3.2 INSTALLATION

- A. Install units level and plumb.
- B. Install units in accordance with details on the Drawings, approved Shop Drawings and as instructed by manufacturer.
- C. Coordinate with General Contractor for location and structural supports for unit installation.
- D. Coordinate with Plumbing Contractor for gas supply line connection and with Electrical Contractor for electrical power supply.

3.3 CLEANING

- A. Clean tar, cement or other dirt from units.
- B. Remove debris and other waste material resulting from installation.

3.4 ADJUSTMENTS

- A. Set air deflectors for proper air delivery.
- B. Check power supply and remote thermostat controls.

END OF SECTION 15550

SECTION 15750
PACKAGED AIR CONDITIONING UNITS - THRU WALL, ROOM TYPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install a packaged, thru the wall air conditioning unit HVAC-1A complete with motors, starters, sleeves, all controls and appurtenances including installation kits for proper operation and to comply with requirements.

1.2 RELATED SECTIONS

1. Division 1, General Requirements.
2. Section 15990, Testing, Adjusting and Balancing of HVAC Systems.
3. Division 16, Electrical.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have at least 5 years experience in producing similar type equipment and shall show evidence of at least 5 installation in satisfactory operation.
- B. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdiction:
1. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections by authorities having jurisdiction.
 2. Local and State Building Codes and Ordinances.
 - a. Rhode Island State Uniform Fire Prevention and Building Code.
 - b. Rhode Island State Energy Conservation Code.
 3. Underwriters' Laboratories, Inc.
 4. National Fire Protection Association.
 5. Air-Conditioning and Refrigeration Institute

C. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. Air Conditioning and Refrigeration Institute Standards No. 210 and 270.
2. Underwriters' Laboratories Listed.

D. Source Quality Control: Perform the following shop tests and inspections at the factory:

1. Coils shall be pneumatically leak tested under water at 200 psig.
2. Fan wheels and shafts shall be statically and dynamically balanced.
3. Refrigeration system and controls shall be tested prior to shipment.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, illustrations, specifications and engineering data to include the following information:
 - a. Dimensions and weight.
 - b. Capacities and performance data.
 - c. Wiring and control diagrams.
 - d. Materials of construction.
 - e. Finishes, color charts, Manufacturer's Standard and Optional colors for selection by the OWNER.
 - f. Mounting details.
 - g. Deviations from Drawings and Specifications.

B. Operation and Maintenance Data:

1. Operation and Maintenance Manuals in conformance with Division 1 including copies of all approved Shop Drawings shall be submitted for approval by the CONTRACTOR and for use by the OWNER.

C. Test Reports: Submit the following test certifications for approval.

1. ARI Label.
2. UL Label.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Material:

1. Units shall be protectively crated.

B. Storage of Material:

1. Store units in a clean, dry area, out of the weather.
2. Cap all connections.
3. Units shall remain in original crate till time of actual installation.
4. Units shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.

1.6 JOB CONDITIONS

A. Protection:

1. Wall openings and penetrations shall be covered to prevent rain and snow from entering building prior to installation of units.
2. It shall be the CONTRACTOR's responsibility to verify location and dimensions of wall openings and coordinate any necessary modifications required for installation of the unit.

PART 2 PRODUCTS

2.1 THROUGH THE WALL AIR CONDITIONING UNIT HVAC-1A

- A. Product and Manufacturer: Provide products of one of the following:
 - 1. Carrier Corporation.
 - 2. Freidrich Air Conditioning and Refrigeration Company.
 - 3. Or equal.
- B. Unit capacity shall be 6,000 BTU.
- C. Type:
 - 1. Self contained.
 - 2. Through the wall installation.
 - 3. Factory assembled and wired, R-22 refrigeration charge and all controls.
 - 4. Electric heat.
- D. Construction:
 - 1. Cabinet:
 - a. 18 gage minimum galvanized steel.
 - b. Slide-out chassis.
 - c. Removable front panel 18 gage minimum.
 - d. Continuous bar stock or extruded discharge grille, coordinate size of grille with existing openings.
 - e. Front mounted access panel for controls operators.
 - f. Sub-base with return air grille.

2. Evaporator Fan:
 - a. Forward curved, centrifugal type.
 - b. Aluminum construction.
 - c. Direct connected with motor.
 - d. Solid state fan speed control.
3. Compressor:
 - a. Hermetically sealed.
 - b. Split capacitor type with thermal overloads, high-low pressure cutouts.
 - c. Externally and internally insulated against vibration.
 - d. Refrigerant control down to 35 F outdoor ambient.
4. Condenser Coil:
 - a. Direct drive propeller type.
5. Condenser Coil:
 - a. Seamless copper tube with mechanically bonded aluminum fins.
 - b. "Evaporating condensate" coil design.
6. Evaporator Coil:
 - a. Seamless copper tube with mechanically bonded aluminum fins.
7. Filters:
 - a. Throwaway.
 - b. Slide-in.
 - c. "No tool" removal.

8. Exterior Louver Grille:
 - a. Heavy gauge extruded aluminum.
 - b. Anodized finish.
 - c. Removable from outside.
9. Motors:
 - a. Permanent split capacitor type.
 - b. Direct drive.
10. Drain Pan:
 - a. Insulated galvanized steel.
 - b. With threaded pipe connection.
11. Finish:
 - a. Cabinet: Factory coated with Acryglas or equal corrosion resistant paint.
 - b. Front Panel: Color to be selected by OWNER from color charts submitted.
 - c. Interior Component: Baked-on enamel finish.
12. Wall Sleeve:
 - a. Dry type.
 - b. Field fabricated, 16 GA. galvanized steel.
 - c. Gasket and/or caulk between AC unit and inside wall sleeve.
 - d. Firmly secure wall sleeve to wall.
 - e. CONTRACTOR to coordinate physical dimensions with actual furnished A.C. unit.

13. Heating:

- a. Electric resistance heating coil.
- b. Factory installed and wired for controls.

14. Accessories:

- a. Sub-base.
- b. Manual damper for outside air control.

E. Controls:

1. General:

- a. Factory wired.
- b. Self contained.

2. Components:

- a. Solid state fan speed control knob.
- b. Heat-off-cool switch, fan-high, fan-low, cool-high, and cool-low switching.
- c. Adjustable thermostat control for cooling and heating.
- d. Prewired refrigerant controls.

3. Operation:

- a. Roomside fan runs continuously.
- b. "Cool" position controls internal refrigeration controls and condenser fan operation in response to unit mounted, factory installed and wired thermostat.
- c. "Heat" position controls electric heating element thru thermostat.

2.2 TOOLS AND SPARE PARTS

A. Spare Parts:

1. One spare set of replacement filters.
2. A can of touch up paint (one quart).

PART 3 EXECUTION

3.1 INSPECTION

- A. Check wall opening for correct fit.
- B. Do not proceed with installation of units until wall sleeves conform to specification requirements.

3.2 INSTALLATION

- A. Mount units as detailed and as recommended by unit manufacturer.
- B. Anchor each unit sub-base to floor.

3.3 ADJUSTMENT AND CLEANING

- A. Remove all debris, waste materials, and loose foreign matter from interior of unit prior to starting fans.
- B. Clean tar, dirt or marks from exterior of unit.
- C. Adjust all controls for proper settings.
- D. Touch up all chips and scratches in factory finishes with materials and colors approved by the manufacturer.

END OF SECTION 15750

SECTION 15821
DEHUMIDIFIER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install the dehumidifier unit for the vapor phase treatment system.

1.2 RELATED SECTIONS

- A. Section 15880 - Ductwork and Accessories

1.3 REFERENCES

- A. ANSI/ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate general assembly, dimensions, weights, and materials.
- B. Product Data: Provide catalog data indicating general assembly, dimensions, weights, materials, and certified performance ratings.
- C. Manufacturer's Installation Instructions: Indicate assembly and setting operations.

1.5 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Include assembly instructions, adjustments, and electrical requirements.
- B. Maintenance Data: Include instructions for lubrication filter replacement, cleaning and spare parts lists.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide a dehumidifier by one of the following:
 - 1. Chromalox Model ADH-020
 - 2. or Equal

2.2 MANUFACTURED UNITS

- A. Units: Factory assembled consisting of casing, heating elements, controls and support element.
- B. Performance: 2000 CFM at 100% relative humidity. Relative humidity shall be lowered to about 50%.
- C. Minimum No. of Elements: 9.
- D. Voltage: 460V, 3 phase.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install in ducts or casings in accordance with SMACNA HVAD Duct Construction Standards, Metal and Flexible.
- C. Insulate exterior of unit as specified for ductwork. Refer to Section 15880.

END OF SECTION

SECTION 15850
MAKE-UP SUPPLY AIR AND CIRCULATION FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install seven packaged propeller make-up air fan complete with accessories.

1.2 RELATED SECTIONS

- 1. Division 1, General Requirements.
- 2. Section 15970, Automatic Temperature Controls.
- 3. Section 15990, Testing, Adjusting and Balancing.
- 4. Division 16, Electrical.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdiction.
 - 1. National Fire Protection Association.
 - 2. Underwriters' Laboratories, Incorporated.
 - 3. National Electric Code.
 - 4. National Electric Manufacturers Association.
 - 5. Local and State Building Codes and Ordinances:
 - a. The BOCA National Building Code.
 - b. The BOCA National Mechanical Code.
 - C. Rhode Island Basic Building Code.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following; except as otherwise shown or specified.

1. Air Moving and Conditioning Association (AMCA) Standard: 210-85 and 300.

C. Source Quality Control: Perform following tests and inspections at factory:

1. Fan blades shall be statically and dynamically balanced.1

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, illustrations, specifications and engineering data showing:
 - a. Dimensions.
 - b. Materials of construction.
 - c. Mounting details.
 - d. Performance Data: AMC approved fan curves, for each model specified.
 - e. Weights.
 - f. Prefabricated curb details.
 - g. Deviations from Contract Drawings and specifications.

B. Test Reports: Submit the following test certifications for approval.

1. AMCA Label.
2. UL Label.

C. *Operation and Maintenance Manuals:*

1. Submit complete installation, operation and maintenance manuals including copies of all Shop Drawings, test reports, maintenance data and schedules description of operation, and spare parts information.
2. Furnish operation and maintenance manuals in conformance with the requirements of Division 1.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Store to keep material clean and free from damage.
- B. Handle to prevent damage during installation and storage.

PART 2 PRODUCTS

2.1 **EQUIPMENT**

A. **Product and Manufacturer:** Provide fans as manufactured by one of the following:

1. American Coolair Corporation.
2. Penn Ventilator Company, Type Muffan-Filtered Makeup Air Fan.
3. Or equal.

B. **Propeller Supply Fan:**

1. Style: Wall mounted. Air supply package.

C. **Construction:**

1. Heavy gage (16 gage minimum) galvanized steel housing with galvanized steel angle reinforcements.
2. Resilient mounted motor.
3. Motor bearings permanently lubricated with sealed ball bearings.
4. AMCA and UL certified labels.
5. Wall Sleeve.

6. Inlet screen type fan guard.
7. Manually adjustable variable speed controller.

D. Motor:

1. Type: Single speed, high efficiency.
2. Enclosure: Totally enclosed, single-phase 115 volt
3. Horsepower:
 - a. Motor to be non-overloading at any point on operating curve of supply fan.
 - b. Motor shall be of sufficient size for rated horsepower capabilities.
4. Mounting: Motor to be end-mounted.
5. Bearings: Permanently lubricated.

E. Drive:

1. Direct drive.

F. Coatings:

1. Standard factory applied coating.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine wall opening for proper size before installation of fan wall sleeve.

3.2 INSTALLATION

- A. Install supply fan in accordance with manufacturer's installation instructions. CONTRACTOR to coordinate for wall penetration.
- B. Anchor to wood panel wall with lag screws or bolts.

3.3 TESTING AND ADJUSTING

- A. Start unit and observe for excessive noise or vibration.

3.4 CLEANING

- A. Remove all debris and waste materials resulting from installation.
- B. Clean tar, dirt and marks from exterior of units.
- C. Touch up all chips in factory finishes.

END OF SECTION 15850

SECTION 15880
DUCTWORK AND ACCESSORIES

PART 1 / GENERAL

1.1 SECTION INCLUDES

A. Scope:

1. Furnish and install complete duct systems with all appurtenances required for proper operation.

1.2 RELATED SECTIONS

1. Division 1, General Requirements. Section 15H51.
2. Make-Up Supply and Circulation Fans.
3. Section 15990, Testing, Adjusting and Balancing of HVAC Systems.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 5 installations.
- B. Requirements of Regulatory Agencies: Comply with the applicable provisions of regulatory agencies below and others having jurisdiction.
1. Local and State Building Codes and Ordinances.
 2. Underwriters' Laboratories, Incorporated.
 3. National Fire Protection Association.
- C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified. Specific provisions of this Contract shall supersede the Standards in case of conflict:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - a. HVAC Duct Construction Standards.

D. Field Measurements: Take field measurements where required prior to installation to ensure proper fitting of Work.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. 1/4-inch scale duct layouts.
2. Dimensions.
3. Details of construction.
4. Details of installation, hanger details and spacing.
5. Manufacturer's literature, illustrations, specifications and engineering data.
6. Screens.
7. Backdraft dampers.
8. Flexible connections.
9. Other technical data related to the specified material and equipment as requested by Engineer.
10. Duct sealants.
11. Deviations from Drawings and Specifications.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store equipment and materials so as to keep free from moisture, damage, and deterioration.

1.6 GENERAL REQUIREMENTS

- A. The Drawings accompanying these Specifications show the general arrangement and extent of work to be done, but the exact location and arrangement of all parts shall be determined as the work progresses, to conform in the best possible manner with its surroundings; the exact location of all parts of the work must be governed by the general building plans and the actual building conditions.
- B. The Drawings are intended as an indication of the arrangement of equipment, ducts, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. It must however, be understood that the piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions, without additional charge.
- C. The connections indicated to the various units are particularly intended as an indication only. The actual connections at the time of installation to be made and arranged as to fully and best suit the requirements of each particular case, adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, or if piping or ductwork can be run to better advantage and at the same time accomplish as good or better results, Contractor, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.
- E. The Drawings preclude indicating thereon, all offsets, fittings, accessories and details which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of his work, and shall arrange his work accordingly,

furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Drawings and Specifications.

PART 2 - PRODUCTS

2.1 DUCTWORK

A. Materials:

1. Aluminum (with 3003 ductwork H-14 alloy and temper):
 - a. Aluminum sheetmetal minimum nominal thickness (B&S Gage):
 - 1) Sizes to 12 inch: 24 gage.
 - 2) Sizes between 13 inch to 30 inch: 22 gage.
 - 3) Sizes between 31 inch to 48 inch: 20 gage.
 - 4) Sizes between 49 inch to 60 inch: 18 gage.
 - 5) Sizes above 61 inch: 16 gage.
 - 6) All outdoor located ductwork shall be 16 gage.
 - b. Ductwork for the following system:
 - 1) All ductwork related to exhaust fans EF-1 thru 3, TF-1.
 - 2) Vapor-phase activated carbon system.
 - c. All hangers supports and fasteners for aluminum ductwork shall be galvanized steel except supports for ductwork located outdoor shall be Type 316L stainless steel.

B. Construction: Conform to SMACNA (Sheetmetal and Air Conditioning Contractors' National Association, Inc.) Standards.

1. All sheet metal duct, plenum and casing construction shall conform to the pressure classifications shown on the Drawings and shall be in accordance with the construction details and installation details in the latest edition of the SMACNA HVAC Duct Construction Standards. This standard is hereinafter referred to as HVAC DS.
2. Rectangular duct construction alternatives selected by the Contractor from HVAC DS tables and shall be identified by duct

system and shall be submitted in schedule form to the contracting authority prior to beginning installation of ductwork.

3. Hanger rods shall be minimum 3/8 inch for all ducts with half perimeter up to 72 inches, and 1/2 inch diameter for all -ducts with half perimeter larger than 72 inches. A pair of rods shall be provided at each duct support point. Maximum hanger spacing shall be 8 feet for ducts with half perimeter up to 72 inches and 6 feet for ducts with half perimeter larger than 72 inches. Hanger Construction and installation shall conform to SMACNA Standards, except as specified.
 4. Stiffener angles shall be of the following sizes and spaced as follows:
 - a. Ducts up to 42-in in either dimension 1-1/2 x 1-1/2 x 1/8-in angles, 4-ft 0-in on centers.
 - b. Ducts 43-in and above in either dimension 2-in x 2-in x 1/4-in, 4-ft 0-in on centers.
- C. Leakage:
1. Not to exceed 5 percent.
- D. Weatherproof: 16 gauge regardless of size.
- E. Sleeves: Where ductwork passes through masonry walls, partitions or floors provide 18 gauge, galvanized steel sleeve and caulk airtight with fire resistant sealant between sleeve and ductwork.

2.2 ACCESSORIES

- A. Belt Guards:
1. Reference: OSHA.
 2. Construction: Expanded hinged steel or hinged sheet steel for weather protection where required.
 3. Size: Fabricate guards to receive 2-inch larger pulleys without alteration to the guard.
 4. Trim openings at shafts for tachometer readings.

5. Motor shaft opening to be slotted for belt adjustment.
 6. Secure guards to driven machine or foundation (not to motors).
- B. Access Doors:
1. Reference: SMACNA Standards.
 2. Type: Gasketed cam lock covers.
 3. Materials: Same as duct.
- C. Flexible Connections: (For fans):
1. Reference: SMACNA Standards for pressure classification of 3 inches water gage.
 2. Material:
 - a. Minimum 1/16-inch thick, 6-inch wide reinforced fabric neoprene sheet.
 - b. 0.080 gauge, 3-inch wide aluminum strip.
- D. Screens: 1/2 inch (13 mm) mesh, aluminum screen with frame and bolt holes for mounting.
- E. Gravity Backdraft Dampers:
1. Construction:
 - a. Multiple, interlocked blades mounted in frame.
 - b. Felt gasketed blade edges.
 - c. Stainless steel or brass bearings.
 - d. Tie rod connecting each blade.
 - e. Counterweights or adjustable spring attached to tie rods.
 - f. Aluminum frame and blades.
 2. Materials:
 - a. Blades: Aluminum 0.020 gage.
 - b. Tie Rod: Aluminum 0.081 gage.
 - c. Louver Arm: Aluminum 0.081 gage.
 - d. Bumpers: Waterproof felt.

- F. Prefabricated Roof Curb:
1. Weatherproof, continuous welded minimum 14 gage aluminum construction.
 2. Insulated with 1-1/2 inch minimum rigid board fiberglass.
 3. 45 degree canted type sides.
 4. Provide curb with gasket as per "C" above and wood blocking to mount curb. Provide flashing and counter flashing at curb as required to make watertight installation.
 5. Twelve inch minimum curb height measured from finished roof to top of pressure treated wood nailer.
 6. Curb to Roof Deck Fasteners: Type 316 stainless steel lag screws and bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished; ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.
- B. Tape and seal all joints as per SMACNA Standards.
- C. Elbows shall have a minimum centerline radius of 1-1/2 times the width of the duct.
- D. Provide flexible connections at inlet and discharge of air handling equipment connecting to ductwork.
- E. Provide access doors for all dampers for inspection and maintenance.
- F. Install all ductwork and accessories to provide a system free from buckling, warping breathing or vibration.
- G. All ductwork shall be suitably supported as per SMACNA Standards.

- H. All ducts at flexible connections with duct fans shall be supported at free end within 12 inches of flexible connection.
- I. Provisions shall be made for supporting all ductwork, dampers, and other ductwork accessories, where necessary.

3.2 ADJUSTMENT

- A. Set volume control devices for approximate positions in preparation for final testing and balancing.
- B. Start fan system and check for excessive leaks and vibration and correct.

3.3 CLEANING

- A. Remove all loose materials and obstructions from interior of ducts.
- B. Remove debris and waste materials resulting from installation.

END OF SECTION

SECTION 15970
AUTOMATIC TEMPERATURE CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install an electric/electronic system of automatic temperature controls complete with all appurtenances.

1.2 GENERAL

1. Descriptions contained hereinafter are for guidance and to show the functions desired. They do not describe or specify all components required to interface equipment. All parts and equipment necessary to meet functional requirements shall be provided.
2. The control system manufacturer shall be completely responsible for the proper operation and functions of all control systems herein specified. He shall be responsible for coordination of all interfaces with other contractors to achieve the required control operation.

1.3 RELATED SECTIONS

1. Division 1, General Requirements.
2. Section 10200, Louvers.
3. Section 15550, Unit Heaters - Gas Fired.
4. Section 15750, Packaged Air Conditioning Units - Thru Wall, Room type.
5. Section 15850, Make-up Supply Air Fans.
6. Section 15990, Testing, Adjusting and Balancing of HVAC Systems.
7. Division 16, Electrical.

D. Products Furnished Under This Section:

1. 24 volt AC low voltage wiring and conduit.
2. Actuators for operable louvers.

3. Thermostats with subbase, HOA switches.
4. Smoke detectors.
5. Transformers where specified or required.
6. Mounting accessories, face plates, junction boxes for smoke detectors, thermostats, etc.

E. Products Furnished Under Other Sections:

1. 480 volt, and 120 volt wiring and conduit (Division 16).
2. Starters unless specified (Division 16).
3. HOA switch (Division 16).
4. Interlock wiring (Division 16).
5. Operating louvers (Section 10200).
6. Gas piping (Section 15120).

1.4 QUALITY ASSURANCE

- A. Standards of Workmanship: All material, equipment and installation shall be in strict accordance with requirements of Division 16, Electrical.
- B. Manufacturers Qualifications: Manufacturer shall have a minimum of 5 years experience in producing substantially similar equipment and shall show evidence of at least 5 installations in satisfactory operation.
- C. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdiction.
 1. Underwriters' Laboratories, Incorporated.
 2. National Fire Protection Association.
 3. Local and State Building Codes and Ordinances.
 - a. Rhode Island Uniform Fire Prevention and Building Code.

b. Rhode Island Energy Conservation Code.

D. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. National Electric Code.
2. Standards of National Electric Manufacturers Association.
3. Institute of Electrical and Electronic Engineers.
4. Instrument Society of America (ISAL).
5. Joint Industrial Council (JIC).

E. Required Manufacturer's Services:

1. Furnish a qualified representative of the manufacturer to supervise or perform the following services.
 - a. Installation of the various control systems specified under this Section.
 - b. Initial startup of the various systems.
 - c. Placing the systems in fully automatic operation.
 - d. Final testing of the control systems.

1.5 SUBMITTALS

A. Ship Drawings: Submit for approval the following:

1. Manufacturer's literature, illustrations, specifications, and engineering data to include the following:
 - a. All items of equipment furnished under this Section.
 - b. Wiring diagrams shall conform to JIC standards.
 - c. Sequence of operation description.
2. Drawings showing fabrication methods, assembly, installation details and accessories.

B. Operation and Maintenance Data: Submit complete manuals including:

1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information, all in conformance with Division 1.

PART 2 PRODUCTS

2.1 DESIGN CONDITIONS

A. Manufacturer: Provide product(s) of one of the following:

1. Honeywell Incorporated.
2. Johnson Service Company.
3. Barber Colman Company.
4. Or equal.

2.2 THERMOSTATS

A. Type: Electric, across the line. 120V, 1Ø, 60 Hz, Room Thermostat (For Exhaust Fans):

1. Heavy duty type.
2. Integral thermometers
3. Adjustable set points.
4. Contacts shall have proper ampere rating for intended use.
5. With locking cover.
6. Subbase with auto-Off-On Switch for manual switching.
7. Honeywell T6051A Thermostat with Q651A subbase or equal.

B. Low Voltage Room Thermostats with Summer/Winter Switches (for gas Fired Unit Heaters):

1. Furnished by gas fired unit heater manufacturer. Refer to specification Section 15H32.

2.3 ACTUATORS - FOR OPERABLE LOUVERS (LM-1 thru 4)

A. Type: Electric, Spring Return; Two Position

1. Oil immersed gear train
2. Line voltage (120 V.A.C.) with unit mounted low voltage control transformer.
3. Mechanical spring shall return actuator to normal position when deenergized.
4. Sufficient torque to operate louver furnished.
5. Two position, power to open, spring return to close.

2.4 SMOKE DETECTORS

A. Duct Mounted: (SD-1, SD-2 & SD-3):

1. Onization type.
2. Cross sectional sampling tube.
3. Two contacts, one open, one closed.
4. Contact Rating: 120 VAC, 2 ampere.
5. Voltage: 120 Volt AC, 120V AC wiring kit.
6. Temperature Range: 32 F to 120 F.
7. Humidity Range: 15 percent to 93 percent.
8. Product and Manufacturer:
 - a. System Sensor, Division of BRK Model DH 400 ACDC.
 - b. Electro Signal Lab, Inc., Series 609.
 - c. Or equal.

- B. Smoke detector installation to conform with NFPA 90A and 72E requirements.

25. NAMEPLATES

- A. White laminated phenolic plastic with minimum 3/16 inch high black engravings.
- B. Nameplates shall be affixed with stainless steel rivets or screws.
- C. Nameplates shall be provided at all thermostats, smoke detectors and control switches, providing information on unit being controlled.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Thermostats shall be installed 5 feet above finished floor.
- B. Where thermostats must be located on exterior walls, provide an insulating mounting panel.
- C. Where operable louvers or dampers are shown on the Drawings furnish sufficient motors to operate the operable louver or damper.

3.2 PERFORMANCE

- A. Sequence of system operation shall be as indicated on the control diagrams and as described on Contract Drawings (refer to Sheet H-1).

3.3 ADJUSTMENT AND TESTING

- A. Adjust all system components for specified operation.
- B. Test each control system for proper operation.

END OF SECTION 15970

SECTION 15980
SVE SYSTEM INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide and install flow meters, pressure gauges, switches transmitters, protectors, temperature gauges, switches and transmitters, level sensors and switches, programmable logic controller and control panel for the SVE system.

1.2 RELATED SECTIONS

- A. Section 11340 - Soil Vapor Extraction Equipment.
- B. Section 15975 - Direct Digital Control Systems.

1.3 REFERENCES

- A. ASME B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
- B. ASTM E1 - Specification for ASTM Thermometers.
- C. FS-GG-G-76 - Gages, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil, Water, Ammonia, Chloro- Fluorohydrocarbon Gases, and Compressed Gases).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Include list which indicates use, operating range, total range and location for manufactured components.
- C. Submit manufacturer's installation instructions under provisions of Section 01300.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 01700.
- B. Accurately record actual locations of instrumentation.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.7 FUNCTIONAL DESCRIPTION

A. General SVE Control System

The SVE Control system will include several independent but interrelated control functions and circuits as described below. A main SVE panel will provide control function to all major SVE system components, and will integrate and interlock the functions of the separate Thermal/Catalytic Oxidation System (Thermox) control panel. Major system components will be provided with Manual-Off-Automatic selector switches to facilitate maintenance, troubleshooting and calibration.

The SVE equipment shelter will be partitioned into potentially hazardous [explosionproof] and non-hazardous areas by means of a sealed partition wall and forced air ventilation; positive pressure on the non-hazardous side and negative pressure on the potentially hazardous side. The main SVE control panel will be located in the non-hazardous side, and will connect to intrinsically safe or explosionproof components through suitably sealed conduit which passes through the partition into the potentially hazardous side.

The Thermox unit will be installed outside and adjacent to the equipment shelter. The Thermox unit control panel will have an air purge system and interlock which will prevent the system from being operated until the panel interior has been suitably purged.

Operation of the Thermox is a prerequisite for automatic operation of the SVE system components. A shut-down alarm condition in the Thermox will shut-down the SVE and conversely, any shut-down alarm condition in the SVE will shut-down the Thermox unit.

B. Thermal/Catalytic Oxidizer

The Thermox system is supplied with its own control panel which is interlocked with the main SVE control system. The Thermox system must go through an air purge cycle and achieve an initial operating temperature [140°F] before it will allow the SVE to start-up or operate automatically. The SVE system will not operate automatically unless/until the Thermox unit has been started and is operating normally. Start-up interlocks are as follows:

Purge Air Supply: The control panel must be air pressurized for 20 minutes

Start-Up Temperature

Sensor: 140°F setpoint must be reached before SVE receives a start-up signal

The Thermox system provides a high temperature control signal [pre-alarm conditions], to open a dilution air valve, thereby cooling the combustion chamber temperature by reducing inlet VOC concentrations and inlet gas BTU contribution, and preventing a high temperature [alarm] shutdown as follows:

High Temperature [Dilution Air] Sensor: 1400°F setpoint [1200°F when using catalyst] will activate a signal to the dilution air valve.

The Thermox system has several shutdown alarm conditions, each of which will signal shutdown of the SVE system.

<u>CONDITION</u>	<u>SETTING/FUNCTION</u>
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High Temperature Shutdown Control:	1450°F setpoint for Thermal [1250°F setpoint for Catalytic]
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High/Low Gas Pressure:	<6" water column >23" of water column
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Power Interruption Flame failure Air Supply Failure, combustion blower	
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C. SVE Vacuum Blower and Vapor Extraction Tank System

1. SVE Vacuum Blower

A positive-displacement rotary, lobe-type vacuum blower will be used to extract soil vapor from the extraction wells and to discharge the extracted vapor to the Thermox system. The SVE vacuum blower will be operated by an AUTO-OFF-MAN three position selector switch, START, STOP and EMERGENCY STOP pushbutton controls. In the AUTO mode the SVE blower START pushbutton will activate the vacuum blower holding circuit, which will not start the vacuum blower until the Thermox [activated and having reached operating temperature] provides a start signal. The STOP and an "EMERGENCY STOP" pushbutton will deactivate the SVE system and deactivate the "Start" holding circuit.

The SVE vacuum blower can be operated in the MAN mode for troubleshooting and maintenance purposes. In the MAN mode, the START

pushbutton will activate the blower holding circuit, and the vacuum blower will run independently of all interlocks except the motor overload, the vapor extraction tank high-high level and the blower discharge high temperature alarms. The STOP or an "EMERGENCY STOP" pushbutton will Stop the SVE system and deactivate the "Start" holding circuit.

The OFF position disengages all control signals to the vacuum blower so that it will not operate.

The SVE system has several shutdown alarm conditions, all of which will also signal shutdown of the Thermox system.

<u>CONDITION</u>	<u>SETTING/FUNCTION</u>
Blower Inlet Vacuum High:	> 11.5 in Hg. vacuum shutdown
Dilution Air Manifold Vacuum:	> 10.5 in Hg. vacuum relief
Blower Discharge Pressure High:	> 2 PSIG shutdown
Discharge Temperature High:	> 200°F shutdown
Vapor Extraction Tank:	High-High Liquid Level shutdown
Vacuum Blower Motor Overload:	Motor starter interlock
Discharge Pump(s) Overload*:	Motor starter interlock

* Note: Depending on operational mode, backup pump may operate in the event of duty pump overload and not shutdown the system.

The Vacuum blower discharge to the Thermox unit will be fitted with a pressure and flow measurement and transmitting device, which will provide a 4 to 20 ma signal to the PLC, which will record the operational flows and pressures.

2. Vapor Extraction Tank

The vapor extraction tank provides a pneumatic vacuum reservoir for the vapor extraction manifold, and it functions as a knockout/receiver tank for removal of water droplets, condensate and particulates which may be entrained in the incoming vapor flow from the extraction well riser. Liquid level sensors in the vapor extraction tank will control the automatic discharge of accumulated water from the vapor extraction tank to the water extraction manifold, and will shutdown the SVE vacuum blower in the event of a high high level condition in the vapor extraction tank (otherwise the vacuum blower is designed to operate continuously).

CONDITION

SETTING/FUNCTION

Vapor Extraction Tank: High level - OPEN tank drain solenoid valve
Low level - CLOSE tank drain solenoid valve
High-High level VES vacuum blower shutdown

3. Vapor Extraction Manifold

The vacuum in the Vapor Extraction Tank is connected to the vapor extraction manifold, where it is delivered to each of the four extraction wells, on demand (separate sensors and circuits control the function of each well).

Each well connection to the vapor extraction manifold will include a check valve, flow control valve, sight glass and solenoid valve.

Each vapor extraction solenoid valve will be operated by an AUTO-CLOSE-OPEN three position selector switch. In the AUTO mode, the solenoid valve will be automatically controlled by the level sensor in the extraction well as described in the EXTRACTION WELL functional description. The CLOSE and OPEN modes will manually control the vapor extraction solenoid valve for maintenance and troubleshooting purposes.

The Vapor Extraction Manifold will be fitted with a manual dilution valve, an automatic dilution valve and a vacuum relief valve [set for 10 in Hg. vacuum], all piped in parallel through a common air inlet filter. The automatic dilution air valve will be controlled by a signal provided by the Thermox high temperature sensor, as described in the Thermal/Catalytic Oxidizer functional description above. The manual dilution air valve will be used for start-up, maintenance and troubleshooting.

The Vapor Extraction Manifold will also be fitted with a connection to the air purge vacuum pump discharge from the Water Extraction Tank System.

D. Water Extraction Pumps and Water Extraction Tank System

1. Water Extraction Pumps

Dual progressive-cavity positive-displacement pumps will be used to extract water from the extraction wells and discharge the extracted water to the groundwater treatment system No. 2 Equalization Tank. The Water Extraction Pumps will be operated by an AUTO-OFF-MAN three-position selector switch, an "A-A/B-B" duty/backup three-position pump selector switch, and an [A/B] alternator/duty-backup circuit which automatically

sequences the pumps for even wear. In the AUTO mode the selected/sequenced water extraction pump is controlled by the vacuum pressure sensor on the water extraction tank to maintain between (say) 24 to 28 inches Hg vacuum in the tank (adjustable), interlocked with the water extraction tank low-low level switch, which prevents dry operation of the pump, and the high-high level switch in the groundwater treatment system No. 2 equalization tank which will shutdown the discharge pump when activated.

<u>CONDITION</u>	<u>SETTING/FUNCTION</u>
Vacuum Level Control:	Low (24"Hg) vacuum - ON High (28"Hg) vacuum - OFF
Water Extraction Tank:	Low-Low level - Water Extraction Pump shutdown
No. 2 Equalization Tank:	High-High level - Water Extraction Pump shutdown

The water extraction pumps can be operated in the MAN mode for troubleshooting and maintenance purposes. In the MAN mode, the selected/sequenced pump will run independently of all interlocks except the motor overload and the No. 2 equalization tank high-high level alarm.

The OFF position disengages all control signals to the water extraction pumps so that neither will not operate.

The vacuum in the water extraction tank is connected to the water extraction manifold, where it is delivered, on demand, to the extraction wells (separate sensors and circuits control the function of each well).

The extraction pump discharge to the No. 2 Equalization Tank will be fitted with a pressure and flow measurement and transmitting device, which will provide a 4 to 20 ma signal to the PLC, which will record the operational flows and pressures.

2. Water Extraction Tank

By maintaining a small volume air pocket in the tank top, the water extraction tank provides a hydraulic/pneumatic vacuum reservoir for the water extraction manifold. An air purge vacuum pump connected to the Water Extraction Tank top evacuates the tank at start-up, and maintains the air pocket volume during system operation, automatically purging excess air (due to air leaks) as controlled by low and high liquid level [conductivity]

sensors in the tank. A vacuum pressure sensor in the water extraction tank will control the extraction pump operation to maintain vacuum within the tank and to discharge accumulated water from the water extraction tank to the No. 2 Equalization Tank of the groundwater treatment system. A Low-Low liquid level sensor in the tank will shutdown the discharge pumps to prevent dry operation, as described in the Water Extraction Pump functional description above.

CONDITION

SETTING/FUNCTION

Water Extraction Tank:	Low level - Start Air Purge Vacuum Pump High level - Stop Air Purge Vacuum Pump
Water Extraction Tank:	Low-Low level - Water Extraction Pump shutdown

3. Water Extraction Manifold

The Water Extraction Tank is connected to the Water Extraction Manifold, where vacuum is delivered to each of the four extraction wells on demand (separate sensors and circuits control the function of each well).

Each well connection to the Water extraction manifold will include a check valve, flow control valve, sight glass and solenoid valve.

Each water extraction solenoid valve will be operated by an AUTO-CLOSE-OPEN three position selector switch. In the AUTO mode, the solenoid valve will be automatically controlled by the level sensor in the extraction well as described in the EXTRACTION WELL functional description. The CLOSE and OPEN modes will manually control the water extraction solenoid valve for maintenance and troubleshooting purposes.

E. Extraction Wells

1. General

Each of four extraction wells will be used to independently extract groundwater and soil vapor from the subsurface. Soil vapor will be extracted directly from a connection to the well riser, while groundwater will be extracted from each well through a coaxial straw, which extends into the well to some depth below the static groundwater level.

Each well will be connected to the water and vapor extraction manifolds and will be configured identically, however each well will be controlled

separately. Within each extraction well a three point liquid level sensor [conductivity sensor] will be used to automatically control the water and vapor extraction manifold solenoid valves, which subsequently control the following:

- water level in the well
- water extraction rate
- vapor extraction rate

Each vapor and water extraction valve will have an AUTO-CLOSE-OPEN three position selector switch, but will normally operate automatically, as controlled by the level sensors in each respective well.

2. Water Extraction Control

The extraction well low level sensor will provide a signal for the water extraction solenoid valve to close, stopping the extraction of water from the well. The low level sensor signal will also open the vapor extraction solenoid valve, starting the extraction of vapor from the well. The high level sensor signal will open the water extraction solenoid valve, starting the extraction of water from the well.

3. Vapor Extraction Control

If the water extraction rate does not keep pace or exceed the rate of water flow into the well, the ascending water level may energize the high-high level sensor which will signal the vapor extraction solenoid valve for that well to close, stopping the extraction of vapor from the well, and relaxing the vacuum applied to that well. With the vacuum in the well relieved, the water extraction rate will increase and the water level will drop. When the low level sensor is deactivated, the water extraction solenoid valve will close and the vapor extraction valve will open, allowing the extraction of soil vapor to start again. Although this sequence of valve openings and closings will provide suitable control of the extraction processes, it is anticipated that by balancing the system flow rates, the water extraction valve (only) will open and close regularly, while the vapor extraction valve remains open.

CONDITION

SETTING/FUNCTION

Extraction Well Low Level

Low - Vapor Valve OPEN

Low - Water Valve CLOSED

Extraction Well High Level

High - Water Valve OPEN

Extraction Well High-High

Level

High-High - Vapor Valve CLOSED

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

A. General

Vendor to provide field mounted indicating pressure gauges with 316 SS Bourdon Tube Element, stainless steel cam and roller, built-in overload and underload movement stops, and full back blowout protection, in quantities as noted in specification body, with the following features:

Vendor shall attach to each piece of equipment an embossed or engraved stainless steel tag bearing the project order number and engineering tag number as indicated.

B. Specification (Range 0-20" Hg Vacuum)

Eng. Tag: PG, 012A, 012B, 012C, 012D, 012E, 012F, 013, 023

Quantity: Eight (8)

Gauge

Service: Gas

Range: 0-20" Hg VAC

Accuracy: Min. 1.0% Full Scale

Dial Size: 4½"

Dial: WHT W/BLK

Movement: 270°

Pointer: Adjustable

Case: Solid Font

Mounting: Bottom Stem

Case Material: Polyester

Element: SS Tube

Lenses: Shatterproof Glass

Process Conn: 316 SS ½" MNPT

Preferred List

Manufacture:

C. Specification (Range 0-30" Hg Vacuum)

Eng. Tag: PG, 011A, 011B, 011C, 011D, 011E, 011F, 015, 031, 030, 026

Quantity: Ten (10)

Gauge

Service: Water
Range: 0-30" Hg VAC
Global Accuracy:
Dial Size: 4-1/2"
Dial: WHT W/BLK
Movement: 270°
Pointer: Adjustable
Case: Solid Font
Mounting: Bottom Stem
Case Material: Polyester
Element: SS Tube
Lenses: Shatterproof Glass
Process Conn: 316 SS 1/2" MNPT
Manufacture:
Preferred List:

D. Specification (Range 0-15" Hg Vacuum)

Eng. Tag: PG-010A, 010B, 010C, 010D, 010E, 010F
Quantity: Six (6)

Gauge

Service: Gas
Range: 0-15" Hg VAC
Global Accuracy:
Dial Size: 4-1/2"
Dial: WHT W/BLK
Movement: 270°
Pointer: Adjustable
Case: Solid Font
Mounting: Bottom Stem
Case Material: Polyester
Element: SS Tube
Lenses: Shatterproof Glass
Process Conn: 316 SS 1/2" MNPT
Manufacture:
Preferred List:

E. Specification (Range 0-30 psig)

Eng. Tag: PG-034, PG-036, and PG-037
Quantity: Three (3)

Gauge

Service: Water

Range: 0-30 psig

Global Accuracy:

Dial Size: 4-1/2"

Dial: WHT W/BLK

Movement: 270°

Pointer: Adjustable

Case: Solid Font

Mounting: Bottom Stem

Case Material: Polyester

Element: SS Tube

Lenses: Shatterproof Glass

Process Conn: 316 SS 1/2" MNPT

Manufacture:

Preferred List:

F. Specification (Range Low Pressure)

Eng. Tag: PG; 038A, 038B and PIT-020

Quantity: Three (3)

Gauge

Service: Gas

Range: 0-4PSIG (PG-038B and PIT-020), 0-30" H₂O (PG-038A)

Global Accuracy:

Dial Size: 4-1/2"

Dial: WHT W/BLK

Movement: 270°

Pointer: Adjustable

Case: Solid Font

Mounting: Bottom Stem

Case Material: Polyester

Element: SS Tube

Lenses: Shatterproof Glass

Process Conn: 316 SS

Manufacture:

Preferred List:

2.2 GAUGE PROTECTORS (One per PG)

A. Diaphragm Seals

Quantity: Twenty-six (26)

Case Conn: 1/2" FNPT
Process Conn: 1/2" FNPT
Mat'l Upper Bowl: 316 SS
Flange Mat'l: N/A
Mat'l Diap: 316 SS
Flange Mat'l: N/A
Mat'l Diap: 316 SS
Fill Fluid: Silicone
Mat'l Boils/Nats: 3/6 SS

2.3 PRESSURE GAUGE ISOLATION

- A. Gage Cock Valve: Tee or lever handle, brass for maximum 150 psig (1034 kPa), Teflon Packing/Seals.

2.4 MAGNETIC FLOW TUBE AND TRANSMITTER

- A. General

Vendor to provide magnetic flow system in quantities as noted in specification body with the following features:

1. Flowtube:

Flowtube shall provide unobstructed flow of process while generating low level, high impedance DC signals proportional to the rate of flow, using the principle of electromagnetic induction. Tube electrodes shall be shaped and tube liner installed so as no process accumulation builds in tube.

A means of grounding will be provided in materials compatible to flowtube material. Flowtube electrical housing shall be NEMA 7.

2. Transmitter:

Transmitter shall provide power to the flowtube magnetic coils, while converting the flowtube signal into a 4-20 ma DC output linear to flow rate. Transmitter will also provide a flow gauge for local indication, and a pulse generated signal for totalization. Transmitter electrical housing shall be NEMA 4.

3. Both flowtube and transmitter shall have an embossed or engraved stainless steel tag attached bearing the project order number and engineering tag number as indicated.

See Section B of this specification for complete process and technical requirements.

B. Specifications

1. Flow Element: (Inline)

Eng. Tag: FIT 032

Quantity: One (1)

Service: Water/Slurry

Proc. Conductivity: 5 Micro Siemens PCR/CM

Temp: AMB. (0-90°F)

Press: 15 PSIG

Flow Min: 15 GPM

Flow Max: 55 GPM

Viscosity: 1

Spec. Gr. 1

Line Size: 2"

Metering Tube Material: Cast Aluminum with Aluminum Oxide 99.5% or
PTFE

Connection: 150* R.F. Flange

Electrode: Elliptical

Elec. Material: 316 SS

Enclosure: NEMA 7

Manufacturer: Preferred List

2. Flow Transmitter (Integral)

Eng. Tag: FIT 032

Scale: 0-55 GPM

Quantity: One (1)

Power Input: 120 VAC, 60 HZ, 1 ϕ

Power Consumption: 50 Watts Max (combined flowtube/transmitter use)

System Accuracy: 0.5% of flow rate

.04 ft/S from low flow cutoff to 1.0 ft/S

Accuracy unaffected by change in process fluid
properties

Damping: Adjustable

Repeatability: 0.1% of reading

Output: *4-20 ma DC isolated, into 0-1000 OHMS, Linear

*0-1000 HZ Pulsed

RFI Protected

Local Readout: Linear Flow Rate

2.5 LEVEL SENSORS AND SWITCHES

A. General

Provide a liquid level detection and control device, based on the conductivity of water (conductivity $>100 \mu\text{s}$) to control the "pump down" and "high level conditions in wells or sealed tanks. This device can be connected for two-point control (high /low) or wired for single point-level control (high or low level alarm), and shall use an electrical ground to the water (through the tank or into the well) as the conductive reference. Where used in tanks, the sensor probes shall be installed into the tanks through electrically insulated fittings welded to the tank wall, and a ground stud will be welded to the tank. Where used in wells, tether-mounted electrodes will be mounted to piping internal to the well, or suspended to a predetermined depth where necessary, with the ground contact with the water made through a conductive pipe or dedicated ground electrode. Service loops (spare cable) shall be provided to allow field adjustment of the water level settings in wells. Sensor wiring into vacuum extraction wells will be potted to prevent the escape of vacuum. Sensor probes and wiring shall be intrinsically safe for use in Class 1 Division 1 atmospheres.

B. Specification (Elements)

1. Tag No.: LE-009A, LE-009B, LE-009C, LE-009D, LE-009E, LE-009F, LE-010A1, LE-010A2, LE-010B1, LE-010B2, LE-010C1, LE-010C2, LE-010D1, LE-010D2, LE-010E1, LE-010E2, LE-010F1 and LE-010F2

Provide a quantity of (18) eighteen electrode fittings, (3) three in each well, for level control in wells VE-1R, VE-2R, VE-3R, VE-9, VE-10 AND VE-11 as follows:

- Electrode suspension wire #16 AWG stranded copper, teflon insulation
- Electrode construction brass or stainless steel, with insulative cups constructed of material compatible with toluene (i.e., nylon, teflon, HDPE) to prevent short circuiting.
- Set the depth of electrodes LE-009(A thru F) at elevations within the extraction wells as indicated on the contract drawings
- Set the depth of electrodes LE-010(A thru F)-1 at elevations within the extraction wells as indicated on the contract drawings.

- Set the depth of electrodes LE-010(A thru F)-2 within the extraction wells above the setting of LE-010(A thru F)-1 as indicated on the contract drawings.
- Electrode wiring service loop in well to accommodate field adjustments
- Wiring potted air-tight where it exits the well to stop vacuum leakage
- Nema-4 junction box mounted to a pipe threaded fitting on the outside of the well to accommodate field wiring/conduit connections.

2. Tag No.: LE-036A and LE-036B

Provide a quantity of (2) two electrode fittings for level control in well VE-7 as follows:

- Electrode suspension wire #16 AWG stranded copper, teflon insulation
- Electrode construction brass or stainless steel, with insulative cups constructed of material compatible with toluene (i.e., nylon, teflon, HDPE) to prevent short circuiting.
- Electrode wiring service loop in well to accommodate field adjustments
- Nema-4 junction box mounted on the outside of the well to accommodate field wiring/conduit connections.

3. Tag No.: LE-025A and LE-025B

Provide a quantity of (2) two point-level sensor probe fittings for level control in tank T-010 as follows:

- Probe assemblies shall be electrically insulated from the tank fitting and walls by an insulator compatible with toluene (i.e., nylon, teflon or HDPE).
- 1-inch NPTM connection through the tank
- Electrode construction brass or stainless steel
- Threaded electrical wiring connection (stud with nut, or screw terminal)

- Probe shall extend 3-inches into the tank
- The probe shall be fitted with a Nema-4 conduit junction box to protect the electrical connection within it
- A ground stud (1/4-20 UNC 2B thread) shall be mounted on the tank adjacent to the sensor probes to provide a conductive ground connection to the tank. It shall be configured such that a conduit box can be to protect the electrical connection (i.e., shoulder stud welded inside a short pipe nipple that is mounted to the tank, with a conduit box mounted to the nipple)
- Each sensor probe shall be used to provide point-level control signals for the conductive fluids within the tank

4. Tag No.: LE-027A1 and LE-027A2

Provide a quantity of (2) two point-level sensor probe fittings for level control in tank T-020 as follows:

- Probe assemblies shall be electrically insulated from the tank fitting and walls by an insulator compatible with toluene (i.e., nylon, teflon or HDPE)
- 1-inch NPTM connection through the tank
- Electrode construction brass or stainless steel
- Threaded electrical wiring connection (stud with nut, or screw terminal)
- Probes shall extend vertically downward into the tank from a fittings on the tank top
- Probe LE-027A1 shall extend into tank T-020 as required to sense liquid level at 95 percent of tank capacity
- Probe LE-027A2 shall extend into tank T-020 as required to sense liquid level at 90 percent of tank capacity
- The probe shall be fitted with a Nema-4 conduit junction box to protect the electrical connection within it

- A ground stud (1/4-20 UNC 2B thread) shall be mounted on the tank adjacent to the sensor probes to provide a conductive ground connection to the tank. It shall be configured such that a conduit box can be to protect the electrical connection (i.e., shoulder stud welded inside a short pipe nipple that is mounted to the tank, with a conduit box mounted to the nipple)
- Each sensor probe shall be used to provide point-level control signals for the conductive fluids within the tank

C. Specification (Level Control Sensor/Switch)

1. Tag No.: LS-009(A thru F), LS010(A thru F), LS-025A, LS-027A, LS-036

Provide (15) conductivity sensors to control liquid levels in extraction and pumping wells and Tanks T-010 and T-020. Electromatic Model EV-220 VAC mounted on 11-Pin DIN rail sockets in a Nema 4 enclosure.

2.6 ELECTRONIC PRESSURE TRANSMITTER

A. General

Vendor to provide a 2-wire electronic pressure transmitter in quantities as noted in specification body with the following features.

- 2-wire transmitter system
- Transmitter to operate on 24V dc power
- 4-20 mA linear output
- Output zero adjustment
- Output span adjustment
- Dampening adjust
- Max. zero elevation 600%
- Max. zero suppression 500% of cal. span
- High accuracy and repeatability .25% of calib. span
- NEMA 4 enclosure
- Integral terminals for screw connections of field wiring
- Electrical connection 1/2" conduit
- Wetted parts including capsule to be 316 sst
- Capsules fill fluid to be silicone
- Class 1, Division 1, nonincendive electronics
- Calibration by factory per specified ranges
- Bolts for flanges to be 316 S.S.
- Mounting bracket to be B3 type for 2" pipe stand flat mounting bracket

- RFI Protection

THE VENDOR SHALL ATTACH TO EACH PIECE OF EQUIPMENT AN EMBOSSED OR ENGRAVED STAINLESS STEEL TAG BEARING THE PROJECT ORDER NUMBER AND ENGINEERING TAG NUMBER AS INDICATED.

B. Specification

Eng. Tag#:	<u>PIT-020</u>	<u>PIT-023</u>	<u>PIT-026</u>	<u>PIT-034</u>
Quantity:	One (1)	One (1)	One (1)	One (1)
Type:	Gauge Press.	Absolute	Absolute	Gauge Press
Elec. Class:	Class 1 Div. 1	Class 1 Div. 1	Class 1 Div. 1	Class 1 Div 1
Service:	Gas	Water Vapor	Gas	Water
Oper. Press:	0-5 psig	0-15"Hg	0-30" Hg	0-30 PSIG
Oper. Temp:	35-150°F	35-150°F	35-150°F	35-150°F
Ambient Temp:	90°F	90°F	90°F	90°F
Process Conn:	½" NPT	½" NPT	½" NPT	½" NPT
Body Mat:	316 SS	316 SS	316 SS	316 SS
Gasket:	316 SS	316 SS	316 SS	316 SS
Diaphragm:	316 SS	316 SS	316 SS	316 SS
Flanges:	316 SS	316 SS	316 SS	316 SS
Bolts/Nuts:	316 SS	316 SS	316 SS	316 SS
Adapters:				
Wetted Parts:	316 SS	316 SS	316 SS	316 SS
Trans Type:	2 wire	2 wire	2 wire	2 wire
Output:	4-20 mA DC Linear	4-20-mA DC Linear	4-20 mA DC Linear	4-20 mA DC Linear
Calib. Range:	0-3 PSIG	30" to 0" Hg	30" to 20" Hg	0-30 PSIG
Volt. Surge Protection:	Yes	Yes	Yes	Yes
RFI Protected:	Yes	Yes	Yes	Yes

Fill Fluid:	Silicon	Silicon	Silicon	Silicon
Manufacturer:				
Model#:				
Calibration:	0 PSIG = 4 mA DC 5 PSIG = 20 mA DC	10" Hg = 4 mA DC 35" Hg = 20 mA DC	0" Hg = 4 mA DC 30" Hg = 20 mA DC	0 PSIG = 4 mA DC 30 PSIG = 20 mA DC
Options:				
Side Drain:	316 SS	316 SS	316 SS	316 SS
Vent Bottom:	316 SS	316 SS	316 SS	316 SS
Local Indicator:	(0-3 PSIG)	(30" Hg to 0" Hg)	(30" Hg to 20" Hg)	(0-30 PSIG)

2.7 PROGRAMMABLE LOGIC CONTROLLER

A. General

Vendor to provide one (1) Modicon PLC Model A984-145 compact system.

The PLCs shall be capable of performing both analog and discrete control functions required to operate the facility with the ability of allowing an operator to monitor, change, and be notified of process conditions in their normal or abnormal state.

The PLC shall be micro processor based and be programmed in written ladder logic, operated by software allowing online and offline operation and network communication.

B. Specification:

Modicon Compact System

Eng Tag # PLC-1

Quantity: One (1) located in SVES Trailer

Type: Modicon Model A984-145 compact system with Mod Bus Plus

Required Design and Construction Features:

1. System to consist of integral processor with 8K logic memory and 1920 registers, having a scan time of 5 ms/k with one (1) mod bus port and one (1) mod bus plus port, with a total of 256 I/O points of any mix and a maximum of 4 local racks.
2. The system shall use Modicon Series A120 I/O Cards of the following type, and the following components:
 - BADU-206-Analog input, 4 point, 4-20 MA - Quantity: (4)
 - BDAP-208 - Discrete isolated relay output, 8 point, 115 Vac - Quantity: (1)
 - HDTA-200 - Main Housing - Quantity: (1)
 - HDTA-201 - I/O Housing - Quantity: (2)
 - P120-000 - Power Supply - Quantity: (2)
 - A984-145 - Controller - Quantity: (2)
 - AS-BDAP-209 - Discrete output, 8 point 115 VAC
 - AS-BDAP-209 - Discrete input, 8 point 115 VAC
3. The PLC permits bidirectional communication with a host computer utilizing the mod bus and mod bus plus ports.
4. Required Operational and Functional Capabilities:
 - Processing capability for a minimum of one PID control loop with analog input signal conditioning, and remote setpoint and ratio control functions.
 - Anti-reset windup.
 - Ramp setpoint capability.
 - Output limiting.
 - Alarming (absolute process and deviation).
 - Calculation Functions:
 1. Addition
 2. Subtraction
 3. Multiplication
 4. Division
 5. Square Root
 - Override control via remote inputs and/or internal program logic.
 - Totalization capability.
 - Digital logic operations.
 - On-Off digital output control.

- Configurable power fail-auto restart in previous mode at last output or in manual at a preset output.
- Balances and pumpless control transfer between all operating modes.
- Internal operating diagnostics to detect hardware malfunctions, memory error, loss of input and low memory battery backup voltage.

2.8 PLC CONTROL CABINET

A. Scope

1. The Control Cabinet enclosure provided by vendor shall be a standard NEMA 12 enclosure as manufactured by Hoffman Engineering, or equal. It will be supplied with subpanel(s).
2. CIBA shall also furnish all equipment as noted in the "Equipment Identification List" located on the Control Cabinet Layout and Detail drawing. Additional details for equipment supplied by CIBA may be found in the CIBA Specifications.
3. VENDOR shall also furnish removable gasket cable access plate(s), terminal block stand-offs, panel cutouts for face mounted instruments, finish paint, and ALL other items necessary to complete the fabrication in accordance with this specification and all applicable CIBA drawings.
4. The VENDOR shall complete the final assembly of the Control Cabinet, including mounting of all devices, wiring, testing, and paint touch-up in accordance with this specification and all applicable CIBA drawings.

B. Definitions

1. The term "VENDOR" shall refer to the Panel Shop where final assembly and wiring of the Control Cabinet is performed.
2. The phrase "or approved equal" means alternate equipment or installation method has been approved for use by the Engineer. Approval is obtained only after VENDOR submits specifications or details of alternative design to CIBA, in wiring, and has been approved, in writing, by the Engineer.

C. Panel Construction

1. The Control Cabinet shall be a NEMA 12 single door, free standing enclosure.

2. The VENDOR shall modify the enclosure as necessary, to provide additional features, if any, as shown on the applicable CIBA drawings.
3. All equipment located inside the panel shall be mounted by the VENDOR using subpanels, welded studs, or framework. No screws or hardware shall protrude through any Control Cabinet exterior surface.
4. Subpanels as shown on CIBA Control Cabinet Layout and Detail drawings are to be considered as a minimum. VENDOR may add subpanel(s) if required to complete the fabrication only after obtaining CIBA written approval. Subpanels shall be minimum 12 gauge steel, mounted on standoffs and removable. All subpanels with a side longer than 8" shall have a one-inch return bend for rigidity.
5. All bolts and hardware used in Control Cabinet construction shall be rust-resistant cadmium plated:

D. Finish

1. Exterior finish all be Sherwin-Williams Polane polyurethane paint, color shall be ANSI No. 62 light gray.
2. Interior finish shall be cabinet manufacturer's standard white enamel.
3. Subpanel(s) furnished by the VENDOR, if any, shall be painted with white enamel to match standard cabinet color.
4. Paint shall be spray applied and shall be free of runs, drips, and sags.
5. The paint manufacturer's instructions shall be strictly adhered to by the VENDOR.

E. Wiring

1. The VENDOR shall furnish all wire, wire markers, wire lugs, mounting hardware, and mount all equipment in place, making all connections tight so they will not loosen from vibration.
2. Wire type and size shall be as follows:
 - 2a. All "Control Circuit" and "Utility Circuit" wires shall be #14 AWG. Both power and control wiring shall be stranded copper with 600 volt rated type S.I.S. moisture and heat resistant insulation. Based upon

availability, VENDOR may select any one of the acceptable types of wire for fabrication of this Control Cabinet. However, all control and utility wiring shall be of the same type. No PVC wire or wire duct shall be used in the panel. Control Circuit wiring shall be color coded as follows:

BLACK All line conductors (1L1, 2L1, etc.) and the positive side of D.C. circuits.

WHITE All neutral conductors (1L1, 2L1, etc.) and the negative side of D.C. circuits.

GREEN All conductors providing ground within the Control Cabinet.

- 2b. All "Instrument Circuits" shall use two twisted shielded #18 AWG conductors in an overall jacket. Twisted conductors shall be stranded tinned copper wrapped in aluminum shield tape with tinned drain wire for electrostatic noise rejection. Conductors shall be insulated with 300 volt rated Rockbestos wire. Insulation shall be color coded as follows:

BLACK Positive (POS) conductor

WHITE Negative (POS) conductor

3. All wire conductors shall be identified at both ends with wire markers using the wire numbers shown on CIBA Control Diagrams. The VENDOR should bring to CIBA's attention for resolution any missing or duplicated wire numbers.
4. Wire markers shall be fire retardant, tubular type, fitted snugly over wire insulation or heat shrink tubular type marker shrunk snugly over wire insulation. Numerals are to be permanently embossed and visible when installed.
5. All internal wiring shall be installed with a "drop loop" of sufficient slack so that wiring is not strained and so equipment is accessible and/or removable for maintenance.
6. All wiring shall be continuous from termination-to-termination point without splices.

7. Connections to devices with pigtails shall be made on a tiepoint block mounted to the interior of the Control Cabinet.
8. Connections to screw type terminal blocks shall be made by means of pre-insulated ring tongue lugs, pressure-crimped to the conductor and insulation of wire. Lugs must be installed using the appropriate ratchet-type crimper.
9. Wire lugs shall be 3M Highland Ring Tongue Connectors with insulating sleeves.
10. Connections to devices with saddle or box type terminal blocks shall be made by inserting the stripped conductor fully into the connector.
11. Connections to devices with push-on type terminals shall be made by means of the appropriate type of pre-insulated push-on lugs pressure-crimped to the conductor and insulation of wire. Lugs must be installed using the appropriate ratchet-type crimper.
12. Wires which are cut or nicked are not acceptable. Wires shall be free from tool marks and abrasions. Minimum bend radius to 1/4" for single conductor wire.
13. All cabinet wiring shall be run in covered wiring duct supplied and installed by the VENDOR. All wiring duct shall be made of non PVC material and be of the restricted slot design as manufactured by Panduit Corporation, or equal.
14. VENDOR shall verify that wiring within duct does not exceed 50% fill. The duct sizes shown on CIBA Control Cabinet Layout and Detail drawings shall be considered as a minimum by the VENDOR and shall in no way imply deviation from nor relieve VENDOR of this requirement.
15. Upon exiting the wire duct, the final 24 inches of cabinet wiring may be run exposed to route to equipment. Exposed wiring shall be neatly bundled and adequately supported using clamps and/or cleats which are plastic or plastic lined. Wiring shall be supported with cable clamps ONLY where wire ducts cannot be installed or as allowed for final runs.
16. Instrument Circuit wiring and low level DC wiring shall be run in bundles and/or ducts completely separate from 120 VAC Control Circuit and Utility Circuit wiring. Where it is necessary for these leads to cross over 120 VAC wiring, they shall cross as near to right angles as possible.

17. All internal wiring and terminal block jumpers shall be installed on the "Panel Wiring" side of terminal blocks. Jumper bars shall not be used on any terminal block.
18. Grommets holes shall be provided for wiring passing through steel mounting plates.
19. Terminal blocks shall be provided by the VENDOR and shall be heavy duty, 600 volt rated Weidmuller. Number of terminal points and location shall be as shown on CIBA Control Cabinet Layout and Detail drawings.
20. All terminal blocks shall be permanently and neatly machine marked, consecutively, as shown on the terminal strip layout drawings. Hand marked terminal blocks are not acceptable.
21. Circuits connected to outgoing terminal strips, including the shielded wire for instrumentation cable, shall be terminated at terminal blocks.
22. No more than two (2) wires shall be terminated on a single terminal. Approximately twenty percent terminal points shall be provided.
23. Terminal block "standoffs" shall be supplied by the VENDOR to allow ample clearance for bundling of field cables.
24. Cable strap brackets shall be provided by VENDOR and shall be installed between adjacent rows of terminal blocks on the "Field Wiring:" side of the block at approximately 18-inch intervals for tie-wrap support of field cables.
25. The VENDOR shall supply a 1" x 1/4" copper Equipment Ground Bus the entire length of the panel which shall include a ground terminal at each end suitable for a #1 to #2/0 AWG conductor (Thomas & Betts No. 32209 connector or approved equal). Equipment Ground Bus shall be fabricated in accordance with details provided on CIBA Control Cabinet Layout and Detail drawings.
26. The Equipment Ground Bus bar shall be securely attached to the Control Cabinet steel by bolting, brazing, or welding. When Equipment Ground Bus is bolted, all paint shall be removed from the contact area and a "no-oxide" grease applied before bolting.
27. The VENDOR shall supply a 1" x 1/4" copper Instrument Ground Bus which shall include a ground terminal suitable for a #1 to #2/0 AWG conductor (Thomas & Betts No. 32209 connector or approved equal). Instrument

Ground Bus shall be insulated from the Control Cabinet steel and fabricated in accordance with details provided on CIBA Control Cabinet Layout and Detail drawings.

28. All ground connections, whether or not shown on CIBA drawings shall be run independently to the appropriate ground bus.
29. The VENDOR shall mount, wire, and provide a neatly typed directory for the distribution panel in accordance with CIBA drawings.
30. Power supplied, voltage regulators and transformers, if required, will be supplied by VENDOR.
31. The VENDOR shall provide utility convenience outlet(s), PLC/Computer terminal outlet(s), interior lighting fixture(s) as shown on CIBA Control Cabinet Layout and Detail drawings.
32. Wire runs between interior lights, light switches, convenience outlets, distribution panel and heating circuits, where applicable, shall be enclosed in thin wall conduit from their source. Flexible conduit shall NOT be used.
33. VENDOR shall mount all PLC equipment, key all I/O slots, set all dip switches and install all modules in accordance with manufacturer's published recommendations.

F. Testing

1. All testing required by this section of the specification shall be performed and CERTIFIED,, in writing, by the VENDOR PRIOR to the performance of function testing by CIBA Engineer.
2. VENDOR shall submit such certification to CIBA as soon as all VENDOR tests are successfully completed. Such notification signifies that the Control Cabinet is totally finished and ready to turn over to CIBA Engineer for functional testing. Any re-testing performed by CIBA Engineer due to incompleteness of the Control Cabinet shall be at the expense
3. Electrical tests shall demonstrate freedom from unintentional ground and accuracy of the wiring for all Control Cabinet mounted devices.
4. All tests shall be performed in accordance with the applicable ANSI Standards.

5. The following test(s) are required to be performed by the VENDOR.

5a. All wiring shall be given a continuity check to verify agreement with CIBA wiring diagram.

Instrument (4-20mA DC) Circuits are NOT subjected to continuity testing. Rather, these circuits are verified by CIBA during functional testing.

6. The VENDOR shall be responsible for proper protection of instruments and devices that may be damaged by testing.

7. CIBA shall perform a functional test of the Control Cabinet in the VENDOR's shop prior to shipment to verify PLC program and Instrument Circuits.

2.9 ELECTRONIC TEMPERATURE TRANSMITTERS

A. General

Vendor to provide a 2-wire electronic temperature transmitter in quantities as noted in specification body with the following features:

- 2-wire transmitter system
- Transmitter to operate on 24V dc power
- 4-20 mA linear output
- Output zero adjustment
- Output span adjustment
- Upscale burnout indication
- Elevation/suppression: .15% of base temperature
- High accuracy and repeatability .2% of calibration span
- Platinum RTD 100 OHM linearized output
- Integral terminals for screw connections of field wiring
- Electrical connection 1/2" conduit
- Class 1, Division 1, nonincendive electronics
- Calibration by factory per specified ranges
- NEMA 4 enclosure
- Mounting bracket to be B3 type for 2" pipe stand flat mounting bracket
- RFI Protection

The vendor shall attach to each piece of equipment an embossed or engraved stainless steel tag bearing the project order number and engineering tag number as indicated.

B. Specification

Eng. Tag No.: TIT-022
Quantity: One (1)
Type Element: RTD 3/16" DIA. 3 wire
Elec. Class: Class 1 Div. 1
Service: Water Vapor
Operating Temp: 150°F
Ambient Temp: 90°F
Process Conn: 3/4" NPT
Temp. Trans.: 2 wire
Output: 4-20 mA DC Linear
Calis. Range: 100-200°F
Volt. Surge Protection: Yes
RFI Protected: Yes
Manufacture: Preferred List
Calibration: 100°F = 4 mA DC
200°F = 20 mA DC

Option: Local Indicator
Thermowell - 316 SS, 3/4" NPT Process Connector, .250 Bore.
See attached sketch for Thermowell Assembly.

2.10 TEMPERATURE INDICATOR

A. General

Vendor to provide on (1) United Electric temperature indicator Type T800 in quantities as noted in specification body, with the following features:

Vendor shall attach to each piece of equipment, an embossed or engraved stainless steel tag bearing the project order number and engineering tag number as indicated.

B. Specification

Tag: TG024 and TG022
Quantity: Two (2)
Service: Gas
Temperature Norm:
Temperature Max: 150°F
Scale: 0-250°F
Bulb Size: 3/8" x 4-1/2" (6 foot long capillary)

Enclosure: NEMA 7:

Options: 316 SS thermowell with 3/4" NPT process connection sized to accept
3/8" x 4-1/2" bulb. U Length = 2-1/2"

2.11 FLOAT LEVEL SWITCH

A. General

Vendor to provide one (1) W.E. Anderson Model L4 Flotect Float Switch with the following features:

B. Specification

Tag No.: LE/LS 027B

Quantity: One (1)

Service: Water

Spec. Gravity: Min 0.7

Float: 316 stainless steel
1 5/8" Dia on 6" ARM

Process Connection: 1 1/2" NPT

Mounting: Horizontal

Switch Body: 316 SS NEMA 4

Switch Action: Open on low low level

Switch Rating: SPDT UNAP Action 120 VAC, 10 AMP

Elec. Class: Class 1 Div 1

Manufacture: Dwyer Instruments, Inc., W.E. Anderson Division

Model No.: L4-SS

2.12 ELECTRONIC CAPACITANCE LEVEL SWITCH

A. General

Vendor to provide point level sensing system with non-coating sensing element for use in aqueous slurries and treated water applications. System will energize and de-energize independent control relays when appropriate level is reached. Vendor to provide quantities as noted in specification body.

B. Specification

Tag No.: LE/LS 0250

Quantity: One (1)

Element

Service: Liquid (water)

Diameter: 1/2"
Length: 14 inches tip sensitive
De-electric Constant:
Material: 316 SS
Wetted Parts: 316 SS
Insulation: Non Coating Teflon
Agitation: N/A
Pressure: N/A
Temperature: 150°F
Process Connection: 3/4" NPT
Mounting: Horizontal
Control Relay
Type: Solid state with adjustable low fixed sensitive resistant
Zero Range: 0 pF to 100 pF
Response Time: 100 milliseconds
Power Supply: 120 Vac, 60 HZ
Contacts: 120 VAC, 5A non-inductive
Contract Arrange: Min, SPST
Temp. Range: -40°F to 140°F
Enclosure: NEMA 4
Manufacturer: Preferred List

2.13 ELECTRONIC PRESSURE TRANSMITTER

A. General

Vendor to provide a 2-wire differential electronic pressure transmitter in quantities as noted in specification body with the following features:

- 2-wire transmitter system
- Transmitter to operate on 24V dc power
- 4-20 mA linear output
- Output zero adjustment
- Output span adjustment
- Dampening adjust
- Max. zero elevation 600% of cal. span
- Max. zero suppression 500% of cal. span
- High accuracy and repeatability .25% of calib. span
- NEMA 4 enclosure
- Intergral terminals for screw connections of field wiring
- Electrical connection 1/2" conduit
- Wetted parts including capsule to be 316 sst
- Capsules fill fluid to be silicone

- Class 1, Division 1, nonincendive electronics
- Calibration by factory per specified ranges
- Bolts for flanges to be 316 sst
- Mounting bracket to be B3 type for 2" pipe stand flat mounting bracket
- RFI Protection

The vendor shall attach to each piece of equipment an embossed or engraved stainless steel tag bearing the project order number and engineering tag number as indicated.

B. Specification

Eng Tag No.: FIT-021

Quantity: One (1)

Type: ΔP

Elec. Class: Class 1, Division 1

Service: Gas (vapor)

Oper. Press: Max. 2 psig

Max ΔP : 1.6" H₂O

Oper. Temp.: 150°F

Ambient Temp.: 90°F

Process Connection: 1/2" NPT

Body Mat: 316 SS

Gasket: 316 SS

Diphram: 316 SS

Flanges: 316 SS

Bolts/Nuts: 316 SS

Wetted Parts: 316 SS

Type Trans.: 2 wire

Output: 2-20 mA dc Linear

Calib. Range: 0-3" WC

Volt. Surge Protection: Yes

RFI Protected: Yes

Fill Fluid: Silicon

Manufacturer: Preferred List

Calibration: 0" WC = 4 mA dc

3" WC = 20 mA dc

Options: Side Drain 316 SS, Vent Bottom 316 SS,

Local Indicator 0-3" WC, 5 Valve Manifold 316 SS

2.14 TUBE FLOW ELEMENT

A. General

Vendor to provide a differential pressure type tube flow element in 316 SS with process block valve and instrument shut-off valves in 316 SS, in quantities as noted in specification body with the following features:

Vendor shall attach an embossed or engraved stainless steel tag bearing the project order number and engineering tag number as indicated.

B. Specification

Tag No.: FE 021

Quantity: One (1)

Pipe Size/Sched: 6" Sch. 40

Pipe ID: 6.065"

Pipe Material: 316 SS

Pipe Design Press:

Process Pressure: 2 psig

Process Temp: 150°F

Fluid: Gas (vapor)

Flow Rate: 0-70,000 SCFH

Spec. Gravity: 1

Flow Coefficient: .6830

ΔP : 1.6" WC (vendor to verify)

Element Material: 316 SS

Process Connection: 1 5/16" MNPT coupling

Manufacturer: Preferred List

2.15 TEST PLUGS

- A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Viton core. Provide test plugs for calibration as indicated on Sheet I-10.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coil and conceal excess capillary on remote element instruments.

- C. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- D. Install gages and thermometers in locations where they are easily read from normal operating level.

END OF SECTION

SECTION 15990
TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Perform the testing, balancing and adjusting of the HVAC system.

1.2 RELATED SECTION

1. Division 1, General Requirements.
2. Section 15550, Unit Heaters - Gas Fired.
3. Section 15750, Packaged Air Conditioning Units - Thru Wall, Room Type.
4. Section 15970, Automatic Temperature Controls.
5. Section 15120 Gas Piping System.
6. Division 16, Electrical.

1.3 QUALITY ASSURANCE

- A. Balancers Qualifications:

1. Submit biographical data on employee proposed to directly supervise the testing, balancing and adjusting work.
2. Include proof of registration in the State of Rhode Island and a record of at least 5 years experience in the mechanical contracting industry, engaged in heating, ventilating and air conditioning work.

1.4 SUBMITTALS

- A. Data Sheets:

1. Submit samples of data sheets on each item of equipment for approval.
2. Submit data sheets on each item of testing equipment required.

3. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

B. Report Forms:

1. Submit specimen copies of report forms.
2. Forms shall be 8-1/2 by 11-inch paper for looseleaf binding, with blanks for listing of the required test ratings and for certification of report.
3. Reports shall be on the organizations approved forms imprinted with the company's name.
4. Certified report outlining procedure used to balance the system and the types of measuring devices used.

C. Fill in test results on approved forms.

D. Submit three certified copies of required test reports to the CONTRACTOR for approval.

1.5 JOB CONDITIONS

- A. Heating, ventilating, air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the test, adjust and balance work specified.

1.6 OPERATING INSTRUCTIONS

- A. Reports shall be certified by the testing engineer that the methods used and the results achieved are as specified.

1.7 CORRECTIVE ADJUSTMENTS

- A. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such work shall be at no additional expense to the OWNER.

B. Inspections:

1. Fan Belt Deflection: No less than 1/4-inch or more than 1/2-inch.

2. Finned Coils: Plate type fins shall be combed out with a fin comb for appropriate fin spacing. Helical fins shall be straightened with blunt bladed instrument.
3. Touch-Up Painting: Examine all equipment and touch-up all scratches, chips or otherwise marred factory finished.

PART 2 INSTRUMENTS

2.1 AIR BALANCE INSTRUMENTS

- A. Provide all velometers, anemometers, pilot tubes, differential air pressure gages, manometers, hook gages, static pressure probe units, etc. as may be required to perform all air balance tests of HVAC equipment, ducts, registers, grilles, etc.

2.2 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

- A. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other instruments as required to measure all facets of the complete HVAC system performance.

PART 3 EXECUTION

3.1 INSPECTION

A. Pre-Startup Inspection:

1. Verify proper equipment mounting and setting.
2. Verify that control, interlock and power wiring is complete.
3. Verify alignment of motors and drives.
4. Verify proper piping connections and accessories.
5. Verify that lubrication is completed.

B. First Run Observations:

1. Verify direction of rotation.
2. Verify setting of safety controls.

3. Monitor heat build up in bearings.
4. Check motor loads against nameplate data.

C. Equipment Check:

1. Verify proper overload heater sizes.
2. Verify function of safety and operating controls.
3. Verify proper operation of equipment.
4. Report on inspection, observation and checking procedures.

3.2 AIR SYSTEMS

A. Test, adjust and balance systems in accord with the AABC "National Standards for Field Measurements, Total System Balance, Air Distribution, Hydronics Systems, Volume One Number 81266", or SMACNA's "Air Handling Specification."

B. Preliminary:

1. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.

C. Ventilation Systems:

1. Test and adjust rpm for all equipment, including each fan, to design requirements within the limits of mechanical equipment provided.
2. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.
3. make pitot tube traverse of main supply, and exhaust ducts, determine cfm at all fans. Adjust fan capacities within plus 3 to plus 10 percent of design requirements.
4. Test and record system static pressure, suction and discharge.
5. Test and adjust system for design outside air, cfm.
6. Record all fan speeds.

7. Record air quantity delivered by each fan.
8. Test and record heating apparatus entering air temperatures, dry bulb (for gas fired heaters).
9. Test and record heating apparatus leaving air temperatures, dry build (for gas fired heaters).

D. Verification:

1. Prepare summation of readings of observed cfm for each system, compare with required cfm, and verify that duct losses are within specified allowable range.
2. Verify design cfm at fans as described above.
3. If the air systems are not properly balanced, CONTRACTOR shall rebalance and recheck all data in the presence of the ENGINEER.

3.4 AUTOMATIC CONTROL SYSTEM

- A. In cooperation with the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.
- B. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment by control system installer.

3.5 MAINTENANCE AND REPAIR

A. Maintenance and Repair:

1. Provide all labor, tools and equipment to provide a preventive maintenance program and make repairs for all equipment and controls for a one year period after final acceptance by OWNER. CONTRACTOR shall provide the following services for the same period of one year:
 - a. Receive calls for all problems and take steps to immediately correct deficiencies which may exist.
 - b. Provide a semi-annual inspection of all equipment, and record the findings on a check list hereinafter specified.

- c. Provide a preventive maintenance schedule for the principle items of equipment.

B. Check List:

1. Provide a check list and post a copy of it where directed by OWNER.
2. Include each piece of equipment specified or shown.
3. Provide 2 columns for required semi-annual inspections.
4. Provide columns for the following:
 - a. Equipment condition.
 - b. Equipment operation.
 - c. Equipment lubrication.
 - d. Preventive maintenance.

Preventive maintenance shall be performed in accordance with the manufacturers' recommendations and accepted practice.

3.7 MANUFACTURER'S SERVICES

- A. Furnish services of a qualified factory-trained serviceman to assist in the installation of the equipment, check the installation before it is placed into operation, supervise initial operations and instruct plant operators in the care, operation and maintenance of the equipment.
- B. Serviceman shall not make less than two visits to the site. The first visit shall be for a period of not less than one 8-hour day to assist in the installation of the equipment. The second visit shall be for a period of not less than one 8-hour day to check the completed installation, to perform the tests, and to instruct plant operators in the proper care, operation and maintenance of the equipment. At least 48 hours advance notice shall be provided prior to instruction period. Informal or unwitnessed instructions or instructions to nondesignated personnel will not be recognized.

END OF SECTION 15990

SECTION 16010
GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all required electrical Work.

1.2 COORDINATION

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the formwork, walls, partitions, ceilings and panels.
2. Coordinate the electrical Work with the work by others including electrical work furnished under Division 13.

1.3 GENERAL

1. Dimensions shown on the Drawings that are related to equipment are based on one manufacturer's equipment. Coordinate the dimensions of the equipment furnished with the space allocated for that equipment.
2. The Drawings show the principal elements of the electrical installation. They are not intended as detailed working drawings for the electrical Work but as a complement to the Specifications to clarify the principal features of the electrical systems.
3. It is the intent of this Section that all equipment and devices, furnished and installed under this and other Sections, be properly connected and interconnected electrically with other equipment so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Drawings.
4. Mounting heights of switches, receptacles, fixtures and other devices noted in the Specifications and on the Drawings are to the bottom of the device.

1.4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:

1. Permits: Obtain all permits required to commence Work and, upon completion of the Work, obtain and deliver to the ENGINEER a Certificate of Inspection and Approval from the State Board of Fire Underwriters or other authority having jurisdiction.
 2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code, the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
 3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Under-writers' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
- B. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:
1. National Electrical Manufacturers Association (NEMA).
 2. The American National Standards Institute (ANSI).
 3. The Institute of Electrical and Electronic Engineers (IEEE).
 4. Insulated Power Cable Engineers Association (IPCEA).
 5. National Electrical Code (NEC).
 6. National Electrical Safety Code (NESC).

1.5 SUBMITTALS

- A. Shop drawings shall include the following information to the extent applicable to the particular item:
1. Manufacturer's name and product designation or catalog number.
 2. Electrical ratings.
 3. Conformance to applicable standards or specifications of ANSI, ASTM, ICEA, IEEE, ISA, NEC, NEMA, NFPA, OSHA, UL, or other organizations.

4. Dimensioned plan, section, and elevations showing means for mounting, conduit connection, and grounding.
5. Materials and finish specification, including paints.
6. List of components including manufacturer's names and catalog numbers.
7. Internal wiring diagram indicating all connection to components and numbered terminals for external connections.
8. Manufacturer's instructions and recommendations for installation, operation, and maintenance.
9. Manufacturer's recommended list of spare parts.

1.6 PROJECT CLOSEOUT

- A. Operation and Maintenance Data: Conform to requirements of Section 01XXX.
- B. Provide certificate of compliance from State Board of Fire Underwriters or other authorities having jurisdiction upon job completion prior to submission of final payment.
- C. Record Drawings: In addition to the requirements of Section 01XXX the record drawings shall include the following:
 1. One line wiring diagrams of the 277/480 volt and 120/208 volt distribution systems.
 2. Actual in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors.
 3. Layouts of the lighting arrangements.
 4. Control wiring diagrams with terminal numbers and all control devices identified.

1.7 PRODUCT DELIVERY

- A. Delivery of Materials: CONTRACTOR shall instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.

- B. Storage: Electrical equipment and material shall be stored and protected in accordance with Sections 1G17, "Storage of Material".

1.8 IDENTIFICATION OF EQUIPMENT

- A. All electrical items shall be identified. Identification shall be in addition to the manufacturer's nameplates and shall serve to identify the item's function and the equipment or system which it serves or controls.
- B. All new equipment shall be identified by means of laminated phenolic nameplates incised to show one-inch high, white letters on a black background. Labels shall be fastened by means of 3/16-inch diameter, round-head, stainless steel, self-tapping screws. Equipment whose designation has been changed shall be relabeled accordingly.
- C. Wires and cables shall be color coded and identified by means of wire markers.
- D. Raceways shall be identified by means of brass tags.
- E. Pull and junction boxes shall be identified with laminated phenolic nameplates showing the names of the feeders or system wires and cables passing through them.
- F. The text, size, and type of lettering, and the location of identifying labels or tags, shall be submitted for approval.

1.9 JOB CONDITIONS

- A. CONTRACTOR shall examine the site and existing facilities in order to compare them with the Drawings and Specifications with respect to the conditions of the premises, location of and connection to existing facilities and any obstructions which may be encountered.
- B. CONTRACTOR is cautioned to perform his work with due regard to safety and in a manner that will not interfere with the existing equipment or in any way cause interruption of any of the functions of the plant.
- C. Work shall be carried out with a minimum amount of disruption to the operation of the existing plant and with prior approval of OWNER. The CONTRACTOR shall submit, for approval, a detailed written procedure for work which affects operation of the existing plant, a detailed procedure for modifying any existing electrical equipment, and anticipated time required to complete the work and the required shutdown time, if any.

- D. Where the work of the CONTRACTOR ties in with existing installations, the CONTRACTOR shall take prior precautions and safeguards in connecting the new work with the existing operating circuits so as to prevent extended interruption to the normal operation of the existing equipment or existing operating circuits. The tying in of new work, installed under this Contract, with the existing circuits shall be performed only in the presence of the OWNER. Advance notice will be required before any equipment is removed from service. The CONTRACTOR shall notify OWNER in writing of his intention to do such work, giving full details.

1.10 AREA CLASSIFICATIONS

- A. Wet Locations: The following areas shall be considered wet locations:
1. All outdoor areas.
 2. All indoor areas below grade unless otherwise specified.
 3. Indoor areas above grade where designated on the Drawings. Materials, equipment and incidentals in areas identified as wet locations shall meet NEC and NEMA requirements for wet locations. Enclosures installed in wet locations shall meet NEMA 4 requirements as a minimum and NEMA 4X requirements where specified. Conduits shall be terminated at enclosures with watertight, threaded hubs.

END OF SECTION 16010

SECTION 16050
CABLE TRAY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. In Building No. 15, install ladder type cable tray.
- B. Coordination: Tray runs are diagrammatic. Coordinate tray installation with other elevated work and equipment and locate so as to avoid interferences.

1.2 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's catalog cuts and technical information for the tray, fittings and supports proposed for use.
- B. Record drawings to provide actual routing of tray runs on record drawings.

PART 2 MATERIALS

2.1 MATERIALS

- A. Aluminum ladder - type cable tray
 - 1. Tray shall be heavy-duty aluminum ladder-type, 6 inches deep and having 9-inch rung spacings for straight sections. All fittings are to have 9-inch rung spacing along centerline. All side rails are to be channels for optimum strength for both vertical and horizontal loads.

2. Splice plates are to be connected to the side channels in a manner such that the resistance between splice plates and side channel is no greater than that required by NEMA standard VE-1 (capable of retaining full fault current return path between plate and side channel).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All cable trays shall be grounded in accordance with NEC Article 318-6

1. The use of cable trays as a fault return path is permitted where suitable bolted mechanical splices are used.
2. Where the cable tray/conduit raceway system is used as the ground circuit return path, install a conduit to tray clamp;
Thomas & Belts 6200 series or Crouse-Hinds type LCCF.
3. Grounding of the cable support system shall be visually inspected to assure conformance to NEC Article 250 and other sections of this specification.
4. Cable tray bonding jumpers shall be installed at expansion joints, discontinuous tray sections, and power source equipment.
5. Cable tray shall be bonded to the grounding electrode system (earth) at all power sources such as substations, switchgear, and motor control centers. Bonding conductors for aluminum cable tray shall be No. 2/0 copper or No. 4/0 aluminum.
6. Cable tray discontinuous sections and expansion connection plates shall be bonded with the same size bonding conductors that are used to bond the cable tray system to the grounding electrode system (earth), and shall be installed as shown on drawings and sketches.

END OF SECTION

SECTION 16111
RIGID CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install conduits, fittings, and pullboxes to form complete, coordinated and grounded raceway systems.

1.2 COORDINATION

- A. Conduit runs shown are diagramatic. Coordinate conduit installation with piping, ductwork, lighting fixtures and other systems and equipment and locate so as to avoid interferences.

1.3 RELATED WORK

- 1. Section 16112, Flexible Conduits.

1.4 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
 - 1. NEC Article 346, Rigid Metal Conduit.
 - 2. NEC Article 347, Rigid Nonmetallic Conduit.
 - 3. UL Standard No. 6, Rigid Metal Electrical Conduit.
 - 4. UL Standard No. 514, Electrical Outlet Boxes and Fittings.
 - 5. UL Standard No. 651, Schedule 40 and 80 PVC Conduit.
 - 6. UL Standard 1242, Intermediate Metallic Conduit.
 - 7. ANSI C80.1, Specification for Zinc Coated Rigid Steel Conduit.
 - 8. ANSI C80.4, Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.

9. NEMA TC2, Electrical Plastic Tubing, Conduit and Fittings.
10. NEMA TC3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 1. Manufacturer's catalog cuts and technical information for the conduit, fittings and supports proposed for use.
 2. Layout drawings showing proposed routing of exposed conduits. Drawings shall show locations of pull and junction boxes and all penetrations in walls and floor slabs.
- B. Record Drawings: Include the actual routing of exposed conduit runs on record drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rigid Steel Conduit, Elbows and Couplings:
 1. Material: Rigid, heavy wall, mild steel, hot dip galvanized, inside and out smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.
 2. Manufacturers: Provide material manufactured by one of the following:
 - a. Allied Tube and Conduit Corporation.
 - b. Republic Steel Corporation.
- B. PVC Coated Rigid Steel Conduit, Elbows and Couplings:
 1. Material: Rigid, heavy wall, mild steel, hot dip galvanized inside and out, smooth interior, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with a factory coating of 40 mil thick polyvinyl chloride, outside, 3 mil phenolic coating inside.
 2. Color: Color of coating shall be the same on all conduit and fittings.

3. Manufacturers: Provide material manufactured by one of the following:

- a. Robroy Industries.
- b. Republic Steel Corporation.

C. Conduit Fittings and Outlet Bodies:

1. Material and Construction: Cast gray iron alloy or cast malleable iron bodies and covers. Outdoor units to be gasketed and watertight. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable. All units to be threaded type with five full threads. Material to conform to ANSI C80.4 and be listed by UL. Fittings and bodies in or on PVC coated conduit runs to have a factory-applied coating of 40 mil thick polyvinyl chloride.

2. Manufacturers: Provide material manufactured by one of the following:

- a. Crouse-Hinds Company.
- b. Appleton Electric Company.
- c. Robroy Industries.

D. Conduit Hubs:

1. Material: Threaded conduit hub, vibration proof, weather proof with captive o-ring seal, zinc metal with insulated throat. Hubs used on PVC cated conduit systems shall have a factory applied PVC coating.

2. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures located in areas designated as wet locations.

3. Manufacturer: Provide material manufactured by Myers Electrical Products Company.

E. Conduit Tags:

1. Material: 19 gauge, 1-1/2-inch diameter round brass with backfilled legend, Style #250-BL as manufactured by Seton Nameplate Corporation.

F. 1. Wireway: Oil tight, lay in type, JIC complete with all connections and fittings as manufactured by Square D Co.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in conformance with National Electrical Code requirements.
- B. Dissimilar Metals:
 - 1. Take every action to prevent the occurrence of electrolytic action between dissimilar metals.
 - 2. Do not use copper products in connection with aluminum work, and do not use aluminum in locations subject to drainage of copper compounds on the bare aluminum.
- C. Supports:
 - 1. Rigidly support conduits by clamps, hangers, channels or conduit racks.
 - 2. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers with steel horizontal members and threaded hanger rods, Kindorff or equal. Rods shall be not less than 3/8-inch diameter, and shall be cadmium coated.
 - 3. For PVC coated rigid steel conduit runs, supports and hardware shall be PVC coated or stainless steel.
 - 4. One-piece Nylon 12 corrosion resistant supports or clamps similar to "Clic" devices by Litchfield International Inc. may be used.
- D. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures by the following methods:
 - 1. To Wood: Wood screws.
 - 2. To Hollow Masonry Units: Toggle bolts.
 - 3. To Brick Masonry: Price expansion bolts, or equal.
 - 4. To Concrete: Phillips; Hilti Corporation; or equal, anchors.

5. To Steel: Welded threaded studs, beam clamps or bolts with lockwashers or locknuts.
 6. In corrosive areas metallic bolts, screws, clips, etc. shall be stainless steel.
 7. To any of the above: Nylon 12 "Clic" devices by Litchfield International Inc.
- E. Plug or cap conduit ends at the time of installation to prevent the entrance of moisture and foreign materials.
- F. Empty Conduits:
1. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.
 2. Identify each empty conduit with a durable tag showing the conduit number indicated on the Drawings.
- G. Orientation:
1. Install parallel or perpendicular to structural members or walls, unless concealed.
 2. Wherever possible, run in groups.
 3. Install on structural members in protected locations.
 4. Locate clear of interferences.
 5. Locations on Drawings are approximate.
- H. Clearance: Maintain 6 inches from hot fluid lines and 1/4 inch from walls.
- I. End Cuts: Square and ream to prevent damage to wire and cable.
- J. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at any bend.
- K. Threads:
1. Apply conductive compound, Kopr-Shield by T&B Corporation to all joints before assembly.

2. Make up joints tight and ground thoroughly.
3. Conduit and fitting threads to be standard tapered pipe threads. Standard straight thread conduit couplings permitted only on exposed indoor conduit runs. Running threads not permitted.
4. Use strap wrenches and vises to install conduit. Conduit with wrench marks shall be replaced.

L. Insulated Bushings:

1. Provide insulated bushings on all conduits entering boxes or cabinets.
2. Provide locknuts on both inside and outside of enclosures except where threaded hubs are provided.
3. Bushings not to be used in lieu of locknuts.

M. Vertical Drops:

1. Rigidly support from equipment or building.
2. Unsecured drop length not to exceed 12 feet.
3. Install vertical runs plumb. No diagonal runs.

N. Thruwall Seals: Install for conduits passing through exterior subsurface walls or base slabs of buildings.

O. Drainage:

1. Pay particular attention to drainage for conduit runs.
2. Wherever possible, install conduit runs so as to drain to one end and away from buildings.
3. Take extreme care to avoid pockets or depressions in conduit.

P. Conduit Curb:

1. In concrete slabs or floors, provide a two inch high curb extending two inches from the outer surface of the conduit penetrating the floor, to prevent corrosion.

2. Terminate conduit stub-ups in couplings, slightly above the finished concrete curb.

- Q. Couplings: Provide full threaded conduit couplings. Split couplings shall not be permitted.
- R. For individual exposed conduits passing through walls, install nonmetallic sleeves to protect the conduit against action of alkaline substances which may be present.
- S. Before concrete is placed, make the necessary location measurements of the conduit to be embedded so that the information is available to prepare record drawings.
- T. PVC Coating: Field apply a 40 mil thick polyvinyl chloride coating to metallic supports and fasteners for PVC coated conduit runs, or use Nylon 12 "Clic" supports.
- U. Core drill for individual conduits passing through existing concrete walls or slabs. Obtain authorization from OWNER prior to core drilling. Seal spaces around conduit with epoxy grout.
- V. Conduit Racks: Provide galvanized conduit racks of suitable width, length and height and arranged to suit field conditions. Support shall be provided at every ten feet minimum.
- U. Signal Conduits: Provide separate steel conduits for 4-20 mA signal cables. Route conduits separate from power conduits and from equipment such as motors, transformers, and inverters, etc. which may generate electrical noise.

3.2 TESTING

- A. Test conduits by pulling through each conduit a cylindrical mandrel not less than two pipe inside diameters long, having an outside diameter equal to 90 percent of the inside diameter of the conduit.
- B. Maintain a record, by number, of all conduits testing clear.

3.3 IDENTIFICATION

- A. Tag all conduits at the ends and in all intermediate boxes, chambers, handholes and other enclosures. Fasten tags to conduits with No. 14 AWG insulated copper wire. Where this method is not practicable, fasten to the adjacent masonry by means of approved expansion screws.

- B. Assign serial numbers to all conduits and a record of the conduit numbers and the cable content by cable designation, size, quantity, origin of conductors, and name of equipment served. Submit conduit identification numbering system for approval. Enter the approved conduit identification numbers on as-built drawings.

END OF SECTION 16111

SECTION 16112 FLEXIBLE CONDUITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. furnish and install flexible metallic conduit and fittings.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified.
 - 1. NEC Article 351, Liquid-Tight Flexible Metal Conduit.
 - 2. UL Standard No. 360, Liquid-Tight Flexible Steel Conduit.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's catalog literature, specifications and technical data for flexible conduit and fittings proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Flexible Conduit:
 - 1. Material: Flexible galvanized steel core with smooth, abrasionresistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1-1/4 inch. Material shall be UL listed.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Sealtite UA by Anaconda Metal Hose Division, Anaconda American Brass Company.
 - b. Liquatite Type L.A. by Electric-Flex Company.

B. Flexible Conduit Fittings:

1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
2. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install at motors and equipment which are subject to vibration or require movement for maintenance purposes- Provide necessary reducer where equipment furnished cannot accept 3/4-inch size flexible conduit. Limit flexible conduit length to three feet maximum and install only where required as noted above.
- B. Install in conformance with National Electrical Code requirements.

END OF SECTION 16112

SECTION 16120
600 VOLT CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install 600 volt cable.

1.2 RELATED WORK

- 1. Section 16170, Grounding System .

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:

- 1. Codes: Cable shall be installed in accordance with the standards and recommendations of the National Electrical Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
- 2. Tests by Independent Regulatory Agencies: Cable shall bear the label of the Underwriters' Laboratories, Inc.

- B. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

- 1. ASTM B 3, Soft or Annealed Copper Wire.
- 2. ASTM B 8, Concentric-Lay-Stranded Copper Conductors, Hard, Medium-hard or Soft.
- 3. IPCEA S-66-524, NEMA WC7-1971, Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- 4. National Electrical Code.
- 5. UL Standard No. 44, Wires and Cables, Rubber-Insulated.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's literature, specifications, and engineering data for 600 volt insulated cable.
- B. Test Records: Submit for review copies of written records of field insulation resistance test results.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Insulated Cable In Raceways:
 - 1. Material: Single conductor copper cable conforming to ASTM B 3 and B 8 with flame-retardant, moisture and heat resistant cross-linked polyethylene or thermoplastic insulation rated 90C in dry locations and 75C in wet locations and listed by UL as Type XHHW or THHN/THWN.
 - 2. Application: Use XHHW for #4 and larger and THHN/THWN or XHHW for #6 and smaller.
 - 3. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for control.
 - 4. Stranding: All 600 volt cable shall be stranded except that solid cable, size 12 and smaller may be used for lighting circuits.
 - 5. Product and Manufacturer: Provide material manufactured by one of the following:
 - a. The Okonite Company.
 - b. Pirelli Cable Corporation.
- B. Multi-Conductor Aerial Cable:
 - 1. Provide assembly of 3-1/C-X HHW-500MCM and 1-1/c #4/OX HHW cabled together with stranded copper-clad steel messenger and copper banding strip.

2. Messenger shall be 9/16" diameter formax span of 150' feet with sag of 2.5' @ 60°F.

C. Cable Connectors, Solderless Type:

1. For stranded wire sizes up to #6 AWG, use compression type.
2. Product and Manufacturer: Provide one of the following:
 - a. T&B Sta-Kon.
 - b. Burndy Hylug.
3. For sizes #4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
4. For sizes #250 MCM and larger, use connectors with at least 2 cable clamping elements or compression indents and provision for at least 2 bolts for joining to apparatus terminal.

D. Cable Markers:

1. Product and Manufacturer: Provide one of the following:
 - a. Omni-Grip by W.H. Brady Company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.
- B. Pulling:
 1. Use insulating types of pulling compounds containing no mineral oil.
 2. Pulling tension shall be within the limits recommended by the wire and cable manufacturer.
 3. Use a dynamometer where mechanical means are used.
 4. Cut off section subject to mechanical damage.

- C. Bending Radius: Limit to 6 times cable overall diameter.
- D. Slack: Provide maximum slack at all terminal points.
- E. Splices:
 - 1. Where possible, install cable continuous, without splice, from termination to termination.
 - 2. Where required, splice in junction box using terminal boards.
 - 3. Splices in conduits not allowed.
- F. Identification: Identify all conductors by circuit number and phase at each terminal or splice location.
- G. Color code power cables in accordance with OWNER standard.

3.2 TESTING

- A. Test each electrical circuit after permanent cables are in place to demonstrate that the circuit and connected equipment perform satisfactorily and that they are free from improper grounds and short circuits.
- B. Individually test 600 volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service with a 1000 volt Megger whose rating is suitable for the tested circuit. Tests shall meet with the applicable specifications of IPCEA S-66-524 and NEMA WC7-1971.
- C. The insulation resistance for any given conductor shall not be less than the value recommended by the IPCEA or a minimum of 1 megohm for 600 volt and less service, if not IPCEA listed. Any cable not meeting the recommended value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.

END OF SECTION 16120

SECTION 16125
INSTRUMENTATION CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. furnish and install instrumentation cable.

1.2 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's literature, specifications and technical data for instrumentation cable proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Single Shielded Pairs:
 - 1. Tinned copper, stranded conductors, No. 18 AWG minimum, twisted with aluminum-polyester shield, stranded tinned 20 AWG copper drain wire and overall chrome vinyl jacket. Rated for 300 volts minimum.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Okonite Type P-OS.
 - b. Belden #8760.
- B. Multipaired Shielded:
 - 1. Tinned copper, 7 strand XLPE insulated conductors, No. 18 AWG minimum, twisted in pairs with aluminum-mylar shield over each pair, silicone rubber fiberglass fire barrier tape, tinned copper drain wire, aluminum mylar overall shield, Hypalon outer jacket.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Okonite Type SP-OS.

- b. Dekoron Poly-set.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install instrumentation cables in conduit separate from power cables unless otherwise noted.
- B. Ground shield at one end only and as recommended by instrument manufacturer.
- C. Terminate stranded conductors with pre-insulated crimp type spade or ring torque terminals.
- D. Install and terminate vendor furnished cable in accordance with vendor equipment requirements.
- E. Install in conformance with National Electrical Code.

3.2 TESTING

- A. Test all 600 volt wiring in conformance with the requirements of Section 16C1, 600 Volt Cable.
- B. Test shielded instrumentation cable shields with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.
- C. Connect shielded instrumentation cables to a calibrated 3-20milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

END OF SECTION 16125

SECTION 16127
HEAT TRACING CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install freeze protection heat tracing cable.

1.2 SUBMITTALS

- A. Detail Drawings: Submit for approval the following:
 - 1. Manufacturer's catalog literature, specifications and technical data for self-limiting heat-tracing cable proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Tinned copper conductors encased in a conductive/resistive core material, with an insulating inner jacket and outer protective jacket.
- B. Product and Manufacture: Provide one of the following:
 - 1. Raychem - Chemelex Auto Trace®
 - 2. Chromalox-Self-Regulating Rapid-Trace®
 - 3. AC Industries - Power Trace®

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install on piping, and valves (process and domestic H₂O) subject to freezing. Provide all necessary materials, including power connection kit, splice kits, grommets and end seals.
- B. Install in conformance with design specifications, vendor instructions and the NEC.

END OF SECTION 1617

SECTION 16130
PULL AND JUNCTION BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. furnish and install pull and junction boxes.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

- 1. NEC Article 370, Outlet, Switch and Junction Boxes, and Fittings.
- 2. UL Standard No. 50, Electrical Cabinets and Boxes.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:

- 1. Manufacturer's technical information for pull and junction boxes proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Junction and Pull Boxes:

- 1. Material and Construction:

- a. Cast gray iron alloy or cast malleable iron bodies and covers. Cadmium finish.
- b. Neoprene gaskets. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable.
- c. Stainless steel cover screws.
- d. External mounting lugs.

- e. Drilled and tapped conduit holes.
 - f. Boxes where conduits enter a building below grade shall have 1/4-inch drain hole.
- 2. Boxes for damp, wet or corrosive locations shall meet NEMA 4X requirements.
 - 3. Large boxes not available in cast construction shall be fabricated from type 304 stainless steel. Boxes shall have continuously welded seams. Welds shall be ground smooth. Box bodies shall be flanged and shall have no holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be fastened with stainless steel screws. Covers on pull boxes larger than 24-inch x 24-inch shall have handles and shall be reinforced and rigid.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount boxes so that sufficient access and working space is provided.
- B. Securely fasten boxes to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no walls or other structural surface exists.
- C. Install pull boxes in runs containing more than three 90 degree bends, runs exceeding 200 feet, where indicated on the Drawings and where required to conform with the National Electrical Code.
- D. Size junction and pull boxes in accordance with the requirements of the National Electrical Code.
- E. Provide terminal blocks in junction boxes where junction or splices are required in cables. Terminal blocks shall be so located as to be readily accessible without interference from wire and cables within the box.

END OF SECTION 16130

SECTION 16170 GROUNDING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install complete grounding for the electrical system.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. NEC Article 250, Grounding.
2. UL Standard #467, Electrical Grounding and Bonding Equipment.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:

1. Manufacturer's technical information for grounding materials proposed for use.
2. Listing of grounding connector types identifying where they are to be used.
3. Layouts of each structure ground grid.
4. Test point construction details.
5. Results of ground resistance tests are each test point.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Bare Ground Cable:

1. Material: Annealed, bare, stranded copper, No. 4/0 AWG minimum size, for ground conductor installed in the earth, No. 6 minimum for equipment ground.

2. Manufacturers: Provide material manufactured by one of the following:

- a. Wire and Cable Division of Cablec Inc.
- b. General Cable Corporation.
- c. Rome Cable Corporation.

B. Ground Rods:

- 1. Material: Copper clad rigid steel rods, 3/4-inch diameter, 10 feet long.
- 2. Manufacturer: Provide ground rods by one of the following:
 - a. Copperweld, Bimetallics Division.
 - b. ITT Blackburn Company.

C. Grounding Connectors:

- 1. Material: Pressure connectors to be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers. Welded connections to be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
- 2. Product and Manufacturer: Provide material manufactured by one of the following:
 - a. Pressure Connectors:
 - 1) Burndy Corporation.
 - 2) O.Z./Gedney, Division of General Signal Corporation.
 - b. Welded Connections:
 - 1) Cadweld by Erico Products, Incorporated.
 - 2) Therm-O-Weld by Burndy Corporation.

PART 3 EXECUTION

3.1 STRUCTURE GROUND SYSTEM

- A. Provide a #4/0 bare copper cable ground grid, minimum 2 feet-6 inches below grade, as shown on the Drawings.
- B. Install ground rods to provide a resistance to ground of less than 5 ohms.
- C. Install #4/0 ground cable from grid to columns as shown on the Drawings. Connect cable to steel using exothermic welds.
- D. Connect grids to a continuous underground water pipe system when practical.
- E. Provide accessible test point for measuring the ground resistance of each grid.
- F. Weld all buried connections except for test point.

3.2 EQUIPMENT GROUNDING

- A. Ground all electrical equipment in compliance with the National Electrical Code.
- B. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where necessary for mechanical protection. Ground conductors pulled into conduits with ungrounded conductors shall be insulated, color coded green.
- C. Connect ground conductors to conduit with copper clamps, straps or with grounding bushings.
- D. Connect to piping by welding or brazing. Use copper bonding jumpers on all gasketed joints.
- E. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use holddown bolts. Where grounding provisions are not included, drill suitable holes in locations designated by the Engineer.
- F. Connect to motors by bolting directly to motor frames, not to sole plates or supporting structures.
- G. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on all gasketed joints.

- H. Scrape bolted surfaces clean and coat with a conductive oxideresistant compound.

3.3 INSTRUMENT GROUND SYSTEM

- A. Install ground conductor from incinerator control panel to grid in one inch PVC conduit to isolate conductor from structural steel, or other grounded equipment grounding conductors.

3.4 TESTING

- A. Test the complete ground systems for continuity and for resistance to ground using an electrical ground resistance tester.

END OF SECTION 16170

SECTION 16440
DISCONNECT SWITCHES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Furnish and install disconnect switches as shown and specified and as required by the National Electrical Code.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
 - 1. National Electrical Code.
 - 2. UL #98, Enclosed Switches.
 - 3. NEMA KS-1, Enclosed Switches.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's technical information for disconnect switches proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Disconnect Switches:
 - 1. Type: Unfused, horsepower rated, heavy-duty, single throw, two pole and three pole with visible blade and safety handle.
 - 2. Enclosure: NEMA 12 for dry, indoor locations, and NEMA 4X for indoor damp, wet or corrosive locations and all outdoor locations.
 - 3. Provide nameplate identifying equipment being disconnected.

4. Manufacturers: Provide products of one of the following:

- a. Square D Company.
- b. General Electric Company.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance. Mount all disconnect switches four feet above floor level.
- B. Securely fasten equipment to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other structural surface exists.
- C. Install disconnect switches where shown on the Drawings. In addition, install disconnect switches at each field mounted instrument, device or panel which receives 120, 208, 240 or 480 volt power.
- D. Install in conformance with National Electrical Code.

END OF SECTION 16440

SECTION 16461
DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. furnish and install dry type 480 volt - 120/280 volt transformers.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where shown or specified:
 - 1. National Electrical Code - Article 450
 - 2. NEMA Standards

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval copies of manufacturer's technical information for transformers proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Dry type transformers shall be provided as shown on drawings:
 - 1. Service: KVA, and voltage as shown on drawing
 - 2. Use natural air draft as cooling medium
 - 3. Average temperature rise of 55° C (Class A) to 150° C (Class H) and may be forced-air cooled with fans.
 - 4. The insulation materials used do not support flame, (self-extinguishing).
 - 5. Full capacity taps; 2 1/2 percent above and below normal.

B. Product and Manufacture: Provide one of the following:

1. Westinghouse
2. Square D
3. General Electric

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install dry type transformer as indicated on power plan.
1. Terminate all incoming and outgoing wiring in compartment provided.
 2. Identify all terminations.

END OF SECTION 16461

SECTION 16465 CONTROL STATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install pushbuttons, selector switches and other control stations.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendation of the following except where otherwise shown or specified.
 - 1. NEMA Standard ICS2-216, Pushbutton, Selector Switches, Indicating Lights and Pushbutton Stations.
 - 2. National Electrical Code.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval copies of manufacturer's technical information for control stations proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Control Stations:
 - 1. Type: Industrial, heavy duty, oiltight construction with clearly marked legend plates.
 - 2. Lockout Stop: Two pushbutton maintained contact type.
 - 3. Pushbutton: Momentary type.
 - 4. Selector Switches: Rotary type with round or oval handles and positioning device to securely hold switch in selected position.
 - 5. Indicating Lights: Transformer type with 6 volt lamp. Lens color red for running, green for stopped or ready and amber for failure.

6. Enclosure: NEMA 12 for dry indoor non-hazardous locations, and NEMA 4X for outdoor and damp, wet or corrosive indoor locations.
7. Nameplates identify equipment controlled if not readily apparent.
8. Products and Manufacturers: Provide one of the following:
 - a. Westinghouse Electric Corporation.
 - b. General Electric Company.
9. Components for MCC's shall match existing, insofar as same are available.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other surface exists.
- C. Install in conformance with National Electrical Code.

END OF SECTION 16465

SECTION 16470
LIGHTING AND DISTRIBUTION PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install lighting and distribution panelboards.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. NEC Article 384, Switchboards and Panelboards.
2. UL Standard #50, Electrical Cabinets and Boxes.
3. UL Standard #67, Electric Panelboards.
4. NEMA PBI, Panelboards.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, specifications and technical data for panelboards proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Panel boards:

1. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles shall be as indicated on the Drawings.
2. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown on the Drawings. Provide ground fault interrupters with trip rating where shown on the Drawings.

3. Branch circuit interrupting capacity minimum 10,000 ampere rms symmetrical; for lighting panels, a minimum 55,000 ampere rms symmetrical for power panel boards.
4. Bus Bars: 98 percent conductivity copper. All 4-wire panelboards shall have a solid neutral bar. All panels shall have ground bus.
5. Main circuit breaker for all panelboards.
6. Branch circuit breakers connected for sequence phasing.
7. Directory: Typed card, with glass cover in frame on back of door giving the circuit numbers and the area or equipment served.
8. Construction Indoor noncorrosive area: Code grade steel, ample gutter space, flush door, flush snaplatch and lock. Surface or flush trim as required.
9. Products and Manufacturers: Provide the following:
 - a. INSTRUMENT POWER PANEL #1 (IPP-1)
Westinghouse Mini-Power Center
3 phase, 60hz, 480Δ volts to 208Y/120 volts. 15 KVA style
No. P48G28T15P
Main Breaker - EHD3040
Secondary Breaker - BR350
Feeder Breakers: (1) - 2 pole 15 amp (GFI)
(16) - 1 pole 15 amp (GFI)
 - b. Power Panel No. 1 (PP-1)
Westinghouse Mini-Power Center
3 phase, 60hz, 480Δ volts to 208Y/120 volts. 30 KVA style
No. P48G28T30P
Main Breaker - EHD3070
Secondary Breaker - EDH3100
Feeder Breakers: (24) - 1 pole 20 amp
 - c. Heat Trace Panel No. 1 (HT-1)
Westinghouse Mini-Power Center
3 phase, 60hz, 480Δ volts to 208Y/120 volts. 30 KVA style
No. P48G28T30P
Main Breaker - EHD3070
Secondary Breaker - EDH3100

Feeder Breakers: (8) - 1 pole 30 amp (GFI)
(6) - 1 pole 20 amp (GFI)

- d. Power Panel Wellhouse No. 3 (PPW-3)
Westinghouse Mini-Power Center
3 phase, 60hz, 480Δ volts to 208Y/120 volts. 15 KVA style
No. P48G28Ti5P
Main Breaker - EHD3040
Secondary Breaker - BR350
Feeder Breakers: (2) - 3 pole 30 amp (GFI)
(4) - 1 pole 20 amp (GFI)
- e. Distribution Panel Wellhouse
Westinghouse POW-R-Line C
100 amp Main Breaker
Feeder Breakers: (1) - 3 pole 25 amp (GFI)
(1) - 1 pole 15 amp (GFI)
space for (6) - 1 pole breakers

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mounting: Install panelboards at locations shown on Drawings. Set cabinets so that top branch circuit breaker is not over 6 feet from the floor. Existing panelboards shall remain in place.
- B. Directory: Complete typewritten directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.
- C. Balance the loads on the panelboards.
- D. Modify existing lighting panel, provide new breakers where shown on Contract Drawings. Revise circuit directory to reflect changes.

END OF SECTION 16470

SECTION 16480
MAGNETIC MOTOR STARTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install motor starters and circuit breakers in motor control centers and individually enclosed motor starters.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable, provisions, and recommendations of the following except where otherwise shown or specified.
 - 1. NEMA Standard ICS2-110, General Standards for Manual and Magnetic Controllers.
 - 2. NEMA Standard ICS2-321 AC General Purpose Class A Controller for Squirrel Cage Induction Motors, 600 volts and less.
 - 3. UL Electrical Construction Materials Directory (NLDX).
 - 4. National Electrical Code.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's literature, specifications and technical data for all magnetic motor starters proposed for use, including control schematics and wiring diagrams shown on the drawings and for the reduced voltage auto transformer type.
 - 2. Drawings showing proposed modifications to existing MCC structures and front panels, to accommodate added starters and circuit breakers, etc.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Type: Magnetic coil operated, FVNR, horsepower rated at 480 volts, 3 pole, with three thermal phase overload protection, set per NEC for motor nameplate full load.
2. Functional Type:
 - a. Circuit breaker combination starter with thermal magnetic circuit breaker, with integral current limiting fuse, as required for installation in existing motor control centers.
 - b. Auto transformer reduced voltage magnetic starter with taps for 50, 65 and 80 percent with contactors for 2 step starting. Tap shall be set as shown on the drawings or as required to accelerate the motor controlled, along with equipment connected.
3. Enclosures: Existing motor control centers and NEMA-1 enclosure for 250 HP reduced voltage auto-transformer starter.
4. Control power transformer fused on primary with two fuses, fused and grounded on low voltage side for each starter.
5. Auxiliary contacts for motor space heaters, remote status signals and interlocks as shown on the Drawings.
6. Three overload relays of the temperature compensated type with overload heaters sized to coordinate with actual motor nameplate being controlled.
7. Nameplate identifying the equipment controlled.
8. Normally open overload contact for remote malfunction.

B. Products and Manufacturers: Provide one of the following:

1. Westinghouse Electric Corporation.

2. General Electric.

3. Allen Bradley.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount equipment so that sufficient access and working space is provided for safe operation and maintenance.
- B. Securely fasten enclosure to wall or other mounting surfaces. Where local wall is not available, provide galvanized steel supports to rigidly support equipment reasonably close to motor.
- C. Modify existing motor control centers as shown on contract drawings. All the circuit breakers to have interrupting capacity and withstand to meet requirements of existing available short circuit. Existing starters, breakers and motor control center were furnished by Westinghouse Electric Corporation. All components shall fit into existing equipment and meet all requirements.
- D. Install in conformance with the National Electrical Code.

END OF SECTION 16480

SECTION 16482
MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install motor control centers.

1.2 COORDINATION

1. Obtain motor nameplate data on equipment being furnished for properly sizing circuit breakers, starters and overloads.
2. Coordinate motor starter schematics with control requirements of local control panels.

1.3 RELATED SECTIONS

1. Section 03300, Cast-In-Place Concrete.

1.4 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
1. UL Standard #845, Electric Motor Control Centers.
 2. NEMA ICS2-322, AC General Purpose Motor Control Centers.
 3. National Electrical Code.

1.5 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Manufacturer's technical information for motor control centers proposed for use.
 2. Outline and summary sheets with schedules of equipment in each unit.

3. Unit control schematic and elementary wiring diagrams showing numbered terminal points and interconnections to other units.
4. MCC terminal compartment wiring diagrams showing external connections to field devices, control panels and to MCC starter units.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Motor control center lineups shall be provided as shown on the Drawings.

1. Service: Voltage rating and number of wires shall be as shown on the Drawings. MCC shall operate from a 3 phase, 60 hertz system.
2. Wiring: NEMA Class II, Type B.
3. Enclosure: NEMA 12.

B. Construction:

1. Totally enclosed structure, dead front, consisting of nominal 20- inch deep, 20-inch wide, 90-inch high vertical sections bolted together to form a unit assembly.
2. Removable lifting angles for each shipping section.
3. Two removable floor sills for mounting.
4. Horizontal wireways top and bottom, isolated from horizontal bus and readily accessible.
5. Isolated vertical wireways with cable supports, accessible through hinged doors, for each controller section.
6. All metal non-conducting parts electrically continuous.

C. Bus System:

1. Rating: Bus bracing and bus current capacities as indicated on the Drawings.
2. All bus bars tin plated copper rated UL heat rise standards.

3. Bus bar connections easily accessible with simple tools.
4. Main Horizontal Bus: Continuous edge mounted, and isolated from wireways and working areas.
5. Vertical Bus: Continuous, and isolated by a glass polyester barrier.
6. Grounding Bus: Full length mounted across the bottom, drilled with lugs of appropriate capacity as required.
7. Neutral Bus: Insulated, continuous through control center for 4 wire services, drilled with lugs of appropriate capacity as required.

D. Unit Compartments:

1. Individual front door for each unit compartment with engraved nameplate identifying equipment. Nameplates to be 1 inch by 3 inches minimum, secured to unit door with two screws.
2. Starter and feeder-unit doors interlocked mechanically with the unit disconnect device to prevent unintentional opening of the door while energized and unintentional application of power while door is open, with provisions for releasing the interlock for intentional access and application of power.
3. Padlocking arrangement permitting locking the disconnect device in the OFF position with at least three padlocks with the door closed or open.
4. NEMA 1 minimum motor starter size. Starter units completely drawout type in Sizes 1 and 2 and drawout type after disconnecting power leads only in Sizes 3 and 4.
5. Motor starters shall include a magnetic contactor, NEMA rated with encapsulated magnet coils. Wound coils not acceptable.
6. Reversing Starters: Single speed full voltage with two contactors and extra interlocking contacts.
7. Reduced Voltage Starters: Autotransformer, closed-transition type with embedded type overtemperature protection. Set on 65 percent starting tap unless otherwise noted.

8. Overload Relays: Three melting alloy type, manually reset from outside the enclosure by means of an insulated button with normally open auxiliary contact for remote alarm purposes and separate heater elements sized for the full load amperes and service factor of the actual motors furnished.
9. Individual control power transformers for all starters, capacity as required for all control circuit devices, 100VA minimum, Class A insulation, two primary fuses, 120 volt secondary, one secondary fuse and the other secondary leg grounded.
10. Separate Control: Where control power to starter is provided by a separate power source, a control power fuse shall be provided in the unit and the main disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.
11. Motor horsepowers shown are preliminary. Circuit breaker trips and starter overload heaters to be coordinated with the actual equipment installed.
12. Auxiliary contacts, relays, timers as required for specified control functions and those shown on the Drawings.
13. All starter devices, including spare contacts wired to numbered terminal blocks.
14. Control devices shall be 600 volt heavy duty, NEMAA600. Relays shall have convertible contacts. Pilot devices shall be oiltight. Pilot lights shall be transformer type with 6 volt secondary.
15. Feeder Circuit Breakers: Thermal magnetic type.
16. Motor Starter Circuit Breakers: Magnetic trip only motor circuit protectors.
17. Terminal Compartments: Provide separate compartments in each motor control center complete with terminal blocks for terminating external control wiring to the incinerator and automatic temperature control panels. Connections between the terminal compartments and MCC starter units shall be factory wired.
18. Provide the following diagrams and tables on the inside of the door for each compartment:
 - a. Elementary wiring diagram.
 - b. Table of overload heater sizes with the correct heater high-lighted.

- c. Table of the motor circuit protector settings with the correct setting highlighted.

E. Spare Parts:

1. Provide the following spare parts for each motor control center lineup:
 - a. Two fuses of each size and type used.
 - b. One auxiliary control relay with at least two normally open and two normally closed contacts.
 - c. One control transformer of each size used.
 - d. Twelve indicating lamps.
2. Package spare parts in suitable containers bearing labels clearly indicating the contents and equipment with which they are to be used. Deliver spare parts at the same time as the motor control centers.

F. Product and Manufacturer: Provide motor control centers of one of the following:

1. Westinghouse Series 2100
2. Square D Company, Model 4
3. General Electric Co. 8000 Line

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install on raised concrete base at locations shown on the Drawings. Install support channels in concrete per manufacturer's recommendations.
- B. For installations against masonry walls, provide an insulation board, 1/4 inch minimum thickness, between motor control center and wall for corrosion protection. Trim board neatly within outline of unit.
- C. Provide no openings in top or side of units not required for conduit.
- D. Cable circuits together within enclosures and identify with durable tag secured to cabling twine.

- E. Set motor circuit protectors at lowest setting which permits motor starting without nuisance tripping.
- F. Field test all motor control center components.
- G. Verify that wiring diagrams on inside of door of each compartment reflects the "as-built" circuitry and that the correct overload heater size and motor circuit protector setting are noted.
- H. Install in conformance with the National Electrical Code.

3.2 MANUFACTURER TRAINING SERVICES

- A. CONTRACTOR shall furnish the services of qualified factory trained specialists from the manufacturer to instruct OWNER'S operations and maintenance personnel in the recommended operation and maintenance of this equipment.

END OF SECTION 16482

SECTION 16500 LIGHTING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install lighting fixtures and to revise and reconnect existing lighting and receptacle systems.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
 - 1. National Electrical Code.
 - 2. UL Standard #57, Electric Lighting Fixtures.
 - 3. UL Standard #1570, Fluorescent Lighting Fixtures.
 - 4. UL Standard #1571, Incandescent Lighting Fixtures.
 - 5. UL Standard #1572, High Intensity Discharge Lighting Fixtures.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's catalog literature, specifications, photometric data and other technical information for lighting fixtures proposed for use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Type: Lighting fixtures are noted in the Fixture Schedule at the end of this Section. Fixtures to be complete with supports, ballasts, lamps and incidentals as required.
- B. Lamps:
 - 1. Fluorescent: Warm white, energy efficient type.

2. High Pressure Sodium: Coated.
- C. Ballasts:
1. Fluorescent: High power factor, energy efficient type, equipped with thermal protectors (Type "P" Ballast), compatible with lamps installed.
 2. High Intensity Discharge: High power factor, constant wattage, stabilized autotransformer with line starting current the same or less than operating current. Low temperature (minus 20°C) where specified.
 3. Ballasts to have "C" sound rating (min.) and be ETL/CBM certified.
 4. Fixtures with 2-two lamp ballasts shall be wired with outboard lamps on one ballast and one circuit, and inner lamps on one ballast on second circuit. Ballasts shall be capable of operating on power supplies having up to 70 percent harmonic distortion.
- D. Hardware: All necessary hangers, supports, conduit adapters, reducers, hooks, brackets and other hardware required for safe fixture mounting shall be furnished. Hardware shall have a protective, non-corrosive finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.
- B. Suspended Fixtures: Pendant mount using 1/2-inch conduit stems. Ground to outlet box. Attach mounting to building structure with expansion anchors. Fixtures shall not be dependent upon the outlet box cover screws for support, unless approved by the ENGINEER.
- C. Surface Mounted Fixtures: Attach to appropriate outlet box.
- D. Boxes and Fixtures:
1. For units mounted against masonry or concrete walls, provide suitable 1/2-inch spacers to prevent mounting back of box directly against wall.

2. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers or Unistrut.
 3. No boxes shall be installed with open conduit holes.
 4. Cable each circuit and identify with tag.
- E. Mounting Heights: Mounting heights or elevations are to bottom of the fixture or to centerline of device.
- F. Install fixtures in conformance with the National Electrical Code.
- G. Existing fixtures which are temporarily removed and reinstalled shall be cleaned, repaired and relamped with new lamps of the same wattage and type as existing.

LIGHTING FIXTURE SCHEDULE

<u>Type</u>	<u>General Description</u>	<u>Mfgr. & Cat No.</u>
B	Wall mounted, enclosed & gasketed, fixture with borosilicate prismatic glass refractor for 100 watt HPS lamp, HPF ballast with 120 volt fused primary.	Holophane # WL2K-100HP12GR-F1 HiTek-TW 100S-SF
E	Shall be on adjustable sealed beam floodlight for operation on a 24 Volt DC battery power supply. Batteries per Notes A&B below.	Dual-Lite Model NF-600-28 Watt Orthobeam 28 Watt Fixture Emergi-lite Double 18 Watt High Intensity Incandescent, EF-9D or equal.
F	Pendant mounted industrial open fluorescent fixture, 4' long with 2x40 W RS lamps, 120 volt, Imperial, white porcelain enameled reflector, with 20-30% uplight.	Miller Cat. No. IL-2101-04-120V
FC	Surface mounted, fluorescent fixture with clear acrylic prismatic wrap around diffuser for 2-40W T12 RS 40 watt lamps. Ballast 120 volts.	Lithonia WA-240A-120V Miller DB-2101-04-120V
FL	Same as Type "F" with attached louver.	
FP	Recessed 2'x4' fluorescent troffer for four (4) F40-T12 rapid start lamps with two 2-lamp type "P" 120V ballasts (one for outside lamps). Fixture shall have an aluminum covered parabolic shaped plastic lens 1-1/2"x1-1/2"x1" louver in hinged door frame for installation in a grid ceiling with exposed T-bar supports.	Lightolier Ventilline Air Handling Cat. No. 64675 Lithonia 2GP440-PC-2-14QV Lightron AFG440-PC-II (2x4) Keystone #2SG440-PWS-120

- | | | |
|-----|--|--|
| H | Ceiling or pendant mounted open industrial type fixture with high bay reflector for 150 watt HPS 100 volt lamp, HPF ballast with 120 volt fused primary and hot instant restrike capability. | Appleton G-HB41AL-MT-HRS
Holophane #PP5K150-HP12POM35-F1 |
| H-1 | Ceiling or pendant mounted open reflector industrial type fixture for low mounting with 150 watt HPS-IOOV lamp, HPF ballast with 120 volt fused primary. | Appleton G-1M452L-MT, Hitek-TG150SALW-120-SF |
| H-2 | Same as Type "A2" with instant restrike feature to restore lamp output upon return of power supply to fixture. | Appleton G-LM452L-MT-HRE
Hitek -TG150SALW-120-SF-Instant Restrike |
| I | Recessed quare fluorescent fixture with two (2) 13W PL lamps with prismatic glass, diecast aluminum trim. Matte white finish and suitable for damp locations, plaster frame and suitable for operation on 120 volts. | Prescolite Cat. No. CF10SQ2S-1-120V |

Note:

- (A) Provide 24 volt DC battery power supply for each stairway emergency lighting. Battery system shall be capable of supplying 328 watts for 1-1/2 hours, to not less than 87.5 percent of nominal system voltage (24 V) equal to Dual-Lite Model 120-24-C-L21XL-MON-XBFA, sealed extra long life lead batteries. Including options ACCB-LVD a set and GLS.
- (B) Provide 24 volt DC battery power supply for equipment area, control rooms, MCC room etc. Battery system shall be capable of supplying 1700 watts for 1-1/2 hours, to not less than 87.5 percent of nominal. Equal to Dual-Lite Model 120-24-C-L26XL-MON-XBFA, sealed extra long life batteries, including options ACCB-LVD-ASET and GLS.

END OF SECTION 16500

APPENDIX A
OPERATING MANUAL - GALGON MODEL 7.5
GRANULAR CARBON ADSORPTION SYSTEM

OPERATING MANUAL

MODEL 7.5 GRANULAR CARBON ADSORPTION SYSTEM

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1.0 INTRODUCTION

This manual covers a general description and operating procedures for the granular carbon adsorption system treating groundwater at Tyson's Site, King of Prussia, Pennsylvania.

Detailed instructions for operating and maintaining the equipment and instruments in the system are contained in the respective manufacturer's literature.

1.1 GLOSSARY

Adsorber - A tank designed to hold 10,000 pounds of granular activated carbon.

Backwash - Method used to remove suspended solids from the carbon bed. Water is pumped into the bottom of the adsorber, flows upward through the carbon bed and exits through the backwash outlet. The counter current flow will expand the carbon bed and remove suspended solids. The backwash water rate will control the percent bed expansion and time required for backwashing.

Carbon Trailer - A tank trailer used to transport up to 20,000 pound loads of granular carbon to and from the subscriber's plant site.

Heel - Any quantity of spent carbon not removed from an adsorber before charging the vessel with fresh carbon.

Lead Adsorber - The first bed of carbon in a series operation adsorption train through which the water stream is passed.

Polish Adsorber - The second bed of carbon in the adsorption train.

Spent Carbon - Carbon that has adsorbed the organic contaminants from the stream being treated.

Super Sac - Container of activated fresh granular carbon containing 1,000 pounds.

Spray Nozzle - Nozzle mounted in top center of adsorber and used for flushing out spent carbon.

Underdrain - A device designed to permit the flow of the water being treated while retaining the granular carbon in the vessel.

Vent - A pressure relief line from an adsorber.

Water Cushion - The water added to an adsorber before charging the vessel with carbon to protect the underdrain and lining.

2.0 DESCRIPTION OF THE FACILITIES

2.1 GENERAL DESCRIPTION

The equipment provided for the treatment system at this site is as follows:

1. Three (3) downflow backwashable GAC treatment vessels; 7.5 ft. diameter with a 12'-0" straight side, ASME rated at 75 psig at 150 degrees F, lined with Plasite 4110. Each vessel is skid mounted complete with underdrain, face piping, carbon transfer piping and sample and instrument connections. Some piping components are shipped loose for installation in the field to facilitate connecting the skids.
2. Each vessel includes vent piping, a rupture disc, compressed air piping (for spent carbon transfer) and drain piping as shown on Drawings 91-88-0770, 0774, 0775 and 0776.
3. Water (process) piping consisting of 3" carbon steel piping, including pipe to and from battery limits, with a valving network for two vessel series flow. (Adsorber A to B, Adsorber B to C, Adsorber C to A)
4. Backwash piping consisting of 8" carbon steel piping.
5. Fresh carbon slurry piping and spent carbon piping to be 2" polypropylene lined carbon steel. Carbon fill and discharge lines are equipped with 3/4" manual flush connections.
6. The system includes influent and effluent pressure gages on the adsorbers.

Each vessel is equipped with a rupture disc and sample taps.

Initially, virgin carbon will be delivered to the site in Calgon Carbon 1,000 pound Super Sacs and will be dry unloaded directly into an empty adsorber. The spent carbon could be returned to a Calgon Carbon Company manufacturing site for thermal reactivation if carbon acceptance testing is done and carbon acceptance approval is reviewed prior to the carbon change-out.

On-going fresh carbon supply and spent carbon removal will be using Calgon Carbon bulk trailers (capacity 20,000 pounds of carbon).

2.2 PROCESS DESCRIPTION

The adsorption system utilizes granular activated carbon (GAC) for efficient removal of dissolved organic compounds from water. Adsorption is a physical process in which the compounds adhere to the surface of the carbon particle. The large surface area contained within the internal pore structure of the granular carbon particle provides the carbon adsorption system with a substantial capacity for the organic compounds to be removed. The adsorption system provides effective exposure of the contaminated water to a quantity of granular activated carbon.

The granular activated carbon adsorption system will consist of three (3) adsorber vessels, appurtenances, and interconnecting piping. Two (2) adsorbers will normally be operated in a series mode.

The water stream to be treated is pumped to the adsorber train by the client at a maximum flow rate of 140 GPM. The adsorption system is operated in a downflow mode with the granular carbon beds in a two-stage series configuration. A flow element indicator/totalizer should be provided by the client on the influent to the system for local indication and totalization.

Each adsorber is filled with about 10,000 pounds of granular activated carbon. Flow is directed into the top of the lead vessel and flows down through the carbon. Initially, adsorption occurs in the upper portion of the carbon bed. As this carbon becomes saturated, adsorption takes place lower in the bed.

Eventually, all the carbon in the adsorber becomes saturated and the contaminant concentration in the effluent from the adsorber increases. When this occurs, the bed should be taken out of service to replace the spent carbon with fresh material. The spent carbon can be transferred as a slurry under pressure into an empty Calgon Carbon trailer.

In two-stage series configuration, the effluent from the lead vessel is directed to the top of the second on-line vessel or secondary unit. Treated water is discharged from the system through the effluent piping. The third vessel will be in a stand-by mode.

At the average design flow rate of 70 gallons per minute (GPM), the empty bed contact time for two vessels on line in series operation will be 70 minutes; 35 minutes per vessel. The contact time is calculated on a "superficial" or "empty bed contact time" basis. The system is designed to handle a peak continuous hydraulic loading of 140 GPM.

When carbon in the adsorber becomes saturated with contaminants adsorbed from the groundwater, the adsorber will be removed from service to replace spent carbon with fresh carbon. Flow will be diverted to the secondary adsorber and the third off-line unit will be placed on-line as the secondary unit. The spent carbon is transferred to an empty Calgon Carbon trailer and the empty adsorber is recharged. Carbon will be replaced and this adsorber will be placed in a stand-by mode.

2.3 OPERATING AND DESIGN CONDITIONS

The design and operating conditions for the adsorption system are as follows:

Stream Characteristics

Description	Airstripped Groundwater
Density at 68 Deg F	62.4 lbs./ft ³
Viscosity at 68 Deg F	1.00 Cp
1,2,3 Trichloropropane	13,750 PPB

Flow Rate

Design Flow	140 GPM
Average Flow	70 GPM

Temperature

Design Operating	Ambient
Maximum Instantaneous	150 Deg F

Nominal System Pressure Drop

Two Adsorbers Operated in Series at
design flow rate of 70 GPM.....6 PSI
of 140 GPM.....15 PSI

BACKWASHING

Backwash initial fill (FS-300)
700 GPM @ 55 Deg F 30 min. duration

Recharge Carbon Backwashing (Reactivated
Carbon)
450 GPM @ 55 Deg F 30 min. duration

Vessel Rating

Design Pressure	75 psig
Design Temperature	150 Deg F

Vessel Capacities

Carbon Quantity	10,000 Pounds
Carbon Volume (10,000 lbs.)	2,675 Gallons

3.0 START-UP

3.1 PRELIMINARY STEPS

All equipment and systems affiliated with the granular carbon adsorption system should be checked out following the equipment manufacturer's instructions. Specific activities to complete before operating the adsorption equipment should include the following:

1. Check all piping connections for proper installation and tightness.
2. Insure that all gages and instruments are functional and installed correctly.
3. Close the valves in the lines around the adsorbers.
4. Initial carbon fill has been completed by Calgon Carbon, see Section 3.3 on wetting.

3.2 FILLING THE ADSORBER WITH CARBON (INITIAL FILL)

When the preliminary steps are completed, the adsorbers are ready for filling with the granular activated carbon. The carbon will be transferred dry into the adsorbers from Calgon Carbon Super Sacs for the initial fill.

1. The first step is to open the manway and close all valves to the adsorber.
2. Add a water heel to the adsorber with treated water to one foot above the underdrain.
3. Fill each vessel with F-300 from 1,000 pound Super Sacs. Scaffolding may be necessary to gain access to the top manway. When Super Sacs are used, a cherry picker or crane should be used to lift the Super Sacs for unloading. A total of 10,000 pounds should be unloaded into the vessel.
4. Once the unit is filled with carbon, place the manway with the gasket in the proper position and tighten the bolts.

3.3 WETTING VIRGIN CARBON

Once the carbon has been placed into the vessels, the carbon needs to be wetted and deaerated. If wetting and deaerating were done improperly, poor carbon utilization may result.

1. Wetting of the carbon with clean water is done by first opening the backwash inlet valves and vent valves.
2. Fill each vessel one at a time in 30 to 60 minutes by adjusting the flow rate to 25 to 50 gpm. Each vessel holds approximately 4,000 gallons of water.
3. Once the adsorber vessel starts to overflow, the water should be turned off immediately.
4. The vessel should sit idle for 24 hours to allow for proper wetting and deaerating.

3.4 BACKWASHING THE ADSORBER

After the virgin carbon has been wetted in an adsorber, and prior to being put on-line, the carbon must be backwashed to: 1) remove the fines and air which can lead to excessive pressure drop and flow restriction through the adsorption unit and 2) to size separate the bed so that future backwashing will return the carbon to approximately the same position in the bed. Refer to Section 4.6 for details. Backwashing may also be required if pressure drop across an adsorber increases due to solids build-up or entrained air.

4.0 OPERATING MODES

4.1 DOWNFLOW SERIES OPERATION

A typical operating sequence for the adsorption system in a two-stage downflow series mode is discussed herein. Valves in the influent and effluent lines are opened or closed as required to set the operation of the carbon vessels in the desired configuration. The first bed in the train is called the lead bed. The second bed is referred to as the polish bed. If the vessels are identified as A, B and C, then the valve positions required can be determined as follows:

<u>Valve Setting</u>	<u>FLOW SEQUENCE</u>
	<u>Two Stage A to B</u>
V1	Open
V2	Closed
V3	Open
V4	Closed
V5	Closed
V6	Open
V7	Closed
V8	Open
V9-V18	Closed

The accompanying diagrams show the valve positions for this operating mode. Two-stage operation of B to C and C to A would be sequenced in a similar manner. When adsorber A becomes spent, it is isolated and the influent is switched to adsorber B. Adsorber C is brought on-line in the polish position. Adsorber A is then ready for carbon replacement.

4.2 TWO STAGE FLOW FROM ADSORBER A TO B

Place Adsorber B in the polish position:
Open Valve V-8, Open Valve V-6

Place Adsorber A in the lead position:
Open Valve V-1
Valves V-2 through V-5, V-7, V-9 through 18 should remain closed

At this point, flow should be established through two adsorbers in series.

4.3 ISOLATE ADSORBER A FOR CARBON TRANSFER

This mode of operation is conducted when adsorber A is taken out of service to change carbon. Water continues to be treated through adsorbers B and C. The valve sequence to take adsorber A off line is:

Open influent and effluent valves on adsorber C
Open Valve V-8 (if not already open)
Close Valves V-1 and V-6
Valves V-3, V-4, V-5, V-7 V-9 through V-18 should already be closed

Flow should now be established through adsorbers B and C in a series mode.

Similar valving is applied for taking adsorber B off line and sequencing flow through adsorbers C and A.

4.4 SPENT CARBON TRANSFER

When the carbon in an adsorber becomes saturated with the compounds being adsorbed from the influent stream, the carbon is said to be spent. At this point, the adsorber is ready to be removed from service to replace the spent carbon with fresh material. The adsorber should be removed from service as indicated in Section 4.0.

The trailer is sized to receive up to 20,000 pounds of spent carbon based on a dry adsorbate free carbon weight. The actual weight of the spent carbon, including the water remaining on the carbon after the trailer is drained, should not exceed the 40,000 pounds trailer limit.

When all the carbon is transferred, the adsorber should be flushed with water to remove the last remaining amount of carbon. When the flushing operation is complete, the adsorber is ready to be filled with fresh carbon from a Calgon Carbon trailer.

4.5 FRESH CARBON TRANSFER

The fresh carbon is transferred to the empty adsorber from a Calgon trailer as a water slurry using plant air pressure. The trailer is filled with plant water to form a slurry. Next, the four (4) inch carbon transfer hose is connected to the carbon inlet line on the adsorber after putting a water cushion in the adsorber, the trailer is pressurized to 15 psig and the carbon transfer is initiated.

When the carbon transfer operation is completed, the trailer is vented and the hoses bled and removed. The adsorber is now ready to be returned to service.

The specific steps required to make the carbon transfer are as follows:

1. Spot the trailer in a convenient location close to the adsorber train. The ground must be level from side to side and, if possible, from front to back.
2. Connect a four (4) inch hose to the four (4) inch connection on the plant water line. Connect the other end of the hose to the carbon fill line #1 on the trailer. (See Trailer illustration)
3. Open one top manway and vent line valve #30 to vent the trailer during filling.
4. Open valve #25 in the carbon fill line and the valve in the plant water line.
5. Fill the trailer with water until full.
6. When the trailer is full of water, close the valves in the plant water line.
7. Close the trailer fill line #25, manway and vent valve #30 and disconnect hose.
8. Place about 1,000 gallons of treated water in the adsorber. This serves as a water cushion to reduce carbon abrasion and protect the underdrain system. This water could be introduced through the backwash line. (Refer to Section 4.6)

9. Connect adsorber fill line to trailer carbon outlet line #2 using a flexible hose.
10. Connect plant air line to trailer fill line #1 using the 1 1/2" air line hose.
11. Close all valves on adsorber.
12. Open the valve in the plant air line and pressurize the trailer to 15 psig.
13. Open the valve in the adsorber vent line.
14. If available, connect a 3/4" water hose to the flush connection on the trailer carbon unloading line #2 and fill the line with water.
15. Open the valve in the carbon fill line on the vessel.
16. Open the trailer carbon outlet valve VT-1, VT-2 and VT-3 individually.

4.6 BACKWASHING ADSORBERS

After fresh carbon has been transferred to an adsorber, and prior to being put on-line, the carbon must be backwashed to remove fines and air which can lead to excessive pressure drop and flow restriction. In addition, the bed will size segregate so that the smaller carbon particles will go to the top of bed and the larger ones will settle to the bottom during backwashing. When the unit is backwashed later for pressure, the carbon particles will settle to the approximate initial position. The adsorber is isolated from service and placed in the backwash mode. Clean backwash water should be added through the underdrain via the backwash water inlet line and conveyed from the adsorber through the backwash water outlet line for disposal. In normal operation, backwashing will be necessary when the pressure drop increases 8 to 10 psig over the start-up pressure drop.

When backwashing an adsorber:

1. Close the influent and effluent valves to the particular adsorber to be backwashed.
2. Open the backwash drain valve on the adsorber to be backwashed.
3. Open the backwash inlet valve to the adsorber to be backwashed.

The backwash water should then be turned on and it will enter the adsorber through the backwash water inlet line and flow up through the underdrain and carbon bed. The backwash water flow should not exceed 700 gpm (55 Deg F) at 75 psig (max.), 30 psig (min.) for Filtrasorb 300 carbon. For reactivated carbon, the backwash water flow should not exceed 450 gpm (55 Deg F). Backwash water should always be introduced at a low flow (100 gpm) and increased gradually to the maximum allowable gpm, visually checking that carbon granulars are not being carried out of the adsorber.

The backwash water discharge from the backwash effluent line should be observed for clarity to determine the duration of backwashing. Upon completion of the backwash, close the backwash water valves. The adsorber is then ready to be placed into service. The expansion is targeted for 35 percent bed expansion.

5.0 SPENT CARBON TRANSFER PROCEDURES

5.1 SITE REQUIREMENT

A flat paved area is needed to support the Calgon trailer weighing up to 100,000 pounds. The required overhead clearance is 12 feet.

Utility requirements are:

Water Line - Two inch terminated with a four inch male Kamlock fitting, 100 gpm at 60 psig.

Air Line - 1 1/2 inch end with a male Kamlock fitting, 100 scfm at 30 psig maximum pressure.

Drain Line - Four inch terminated with a male Kamlock fitting or a drainage trench to handle up to 300 gpm of contaminated water from the Calgon trailer.

5.2 SPENT CARBON TRANSFER TO A CALGON TRAILER

Spent carbon is transferred from the adsorber into an empty Calgon Carbon trailer. The adsorber is first removed from service following the procedures given in Section 4.0. The spent carbon is transferred as a water slurry into the trailer by pressurizing the adsorber with air. The specific steps to complete the spent carbon transfer are as follows:

1. Connect a two (2) inch hose (bushed up to four (4) inch Kamlock) from the carbon outlet line on the adsorber to the trailer fill line (four inch Kamlock).
2. Connect a four (4) inch hose from the trailer drain line to the plant drain line or trench.
3. Open the valve in the trailer vent line.
4. Open the valve in the plant air line to the adsorber and pressurize the vessel to 30 psig.
5. When the adsorber pressure reaches 30 psig, open the valve in the carbon discharge line and start the carbon flow into the trailer.
6. Also, open the valves in the front septum line on the trailer to begin draining water from the trailer.
7. The transfer should take between 15 and 20 minutes. The transfer is complete when an air flow is detected in the carbon transfer line and the adsorber pressure starts to drop. At this point, close the valve in the carbon discharge line while leaving the valve in the air line to the vessel open.
8. A small heel of carbon will likely remain in the adsorber, and this material will need to be removed. To remove the remaining carbon, first open the spray line to the adsorber and add water to the vessel for 2-3 minutes, then close the valve.
9. When the pressure in the vessel reaches 30 psig, open the valve in the carbon line and transfer the remaining amount of carbon into the trailer.

10. When air flow is detected in the carbon line, close the valve in the air line and allow the adsorber to vent through the trailer until the pressure decreases to zero. At this point, close the valve in the carbon discharge line on the bottom of the adsorber and flush the line with plant water into the trailer.
11. Open the valves in the rear septum line on the trailer and continue draining the trailer.
12. The trailer can be pressurized with air to speed up the draining process. To accomplish this, first close the valve in the trailer vent line and connect the air line to the trailer air connection.
13. Open the valve in the air line and increase the pressure on the trailer to 15 psig. With air pressure on the trailer, the blowdown time from a full trailer should take about 60 minutes.
14. When air flow is detected in the drain line, close the valve in the front septum. Continue draining water until air flow is again detected in the drain line.
15. When all the water is drained from the trailer, close the valve in the air line, open the valve in the trailer vent line to bleed off the air pressure, bleed off the pressure in the air line and disconnect the hose.
16. Repeat the above procedure as needed to remove all the free water from the trailer.

The carbon transfer operation is now complete. The adsorber should be completely empty and ready to be filled with carbon.

6.0 GENERAL SYSTEM INFORMATION

6.1 RECOMMENDED RECORDKEEPING

Normally, operation data is taken for: 1) Flow rates 2) Which beds are online and their position (lead/lag) 3) Pressure drop across the bed 4) Necessary analytical work for influent, effluent to each adsorber. This may include: pH, TOC level, individual contaminant levels, and inorganic levels.

6.2 SHORT DURATION SHUTDOWNS

For short duration shutdowns lasting less than one or two weeks, little needs to be done. The valves in the water lines to and from the adsorber train should be opened. The feed pumps should be shut down and the valves closed in the lines to and from the pumps. Any drain valves in the pump casing should be opened for the duration of the shutdown.

6.3 EXTENDED SHUTDOWNS

For extended shutdown periods, in addition to the steps in Section 6.2, the adsorber should be drained.

Upon start-up, if biological growth is suspected, the following procedures should be followed to disinfect the carbon bed:

1. Backwash the adsorber to rid the system of air (refer to Section 4.6).
2. Inject 1-5% NaOH through the underdrain via the 1 1/2" drain line at a low rate until the pH out of the adsorber is 12-14.
3. Allow the adsorber to soak for a minimum of 8 hours, preferably overnight.
4. Backwash the adsorber until the pH of the effluent equals that of the influent.
5. Bring the adsorber back on-line in the downflow mode, monitor the effluent for coliform count and monitor the pressure drop.

6.4 EMERGENCY PROCEDURES

In the event a malfunction should occur, which causes a shutdown of an adsorber, the flow should be directed to the remaining two adsorbers in the system or the flow to the system can be stopped.

If a major leak or similar problem develops, flow to the adsorber should be shut down immediately and Calgon Carbon contacted. Proper safety procedures should be observed at all times to prevent damage to the equipment or injury to personnel.

6.5 OXYGEN DEMAND CREATED BY CARBON IN CONFINED VESSELS

Research efforts have confirmed that wet granular activated carbon confined in large vessels adsorbs oxygen which is hazardous to human health and can cause death unless proper safety precautions are observed.

The laboratory experiments conducted since that time also have revealed that commercial activated carbons in a wet or moist condition will lower the oxygen content of an isolated space.

Preliminary indications of this research are:

1. The phenomenon occurs with wet activated carbon of all common types.
2. The rate of oxygen uptake naturally varies with the degree of exposure of the wet carbon to the air. Thus, it is relatively rapid in a drained bed.
3. There is some indication of a limit to the carbon's capacity for oxygen, but until more is known, it would be prudent to assume that all carbons (fresh, used, reactivated) will also exhibit this characteristic. Similarly, although these tests were run with water, it should be assumed that the phenomenon will occur in other liquid and vapor systems.

6.6 SAFETY

Vessel Entry

Based on the properties of wet activated carbon in Section 6.5, a confined space entry procedure should be established for any facility using carbon in confined vessels.

All confined spaces, including those containing activated carbon, should be presumed to be hazardous. Appropriate safety measures should always be taken before entering, as well as when workers are in a confined space. OSHA regulations applicable to respiratory protection in oxygen deficient atmospheres should be strictly adhered to.

Vessel Protection

Pressure gages have been installed to determine the pressure drop across each carbon bed. Taking periodic pressure readings will give the operator the capability of monitoring the pressure drop across the carbon vessels over time. If a pressure increase is observed, then corrective action can be taken before the pressure drop becomes a problem.

Rupture discs are provided to protect the vessels against over pressurization.

6.7 OPERATIONAL CHANGES

Optimum operation of the facility is obtained if changes to the system occur slowly. Rapid changes in flow will cause upsets to the adsorbers which could adversely affect the operation. Valves should be turned slowly at all times to prevent hydraulic shock.

6.8 SPENT CARBON HANDLING

The spent carbon is transferred as a slurry via hoses from an adsorber to an empty Calgon Carbon trailer thereby minimizing worker contact with the carbon and the adsorbed organics it contains. Assuming the carbon is acceptable to Calgon Carbon for reactivation, it shall be transported to one of our resource recovery facilities for thermal reactivation (total destruction of the adsorbed organics). The classification of the spent carbon is determined by the generator, and appropriate personnel safety precautions should be taken.

A micromet carbon assembly is installed on the skid in order to have easy access to a sample of spent carbon for laboratory evaluation by Calgon Carbon. The valves on the unit should be opened at startup to allow untreated influent water to flow through the carbon. The assembly should be sent to Calgon prior to spent carbon removal from the lead adsorber.

6.9 MINOR MAINTENANCE

Minor maintenance is that frequent maintenance to be performed by the plant to ensure continuous and effective operation of the Calgon Carbon facility. This maintenance includes visual check of pressure gages and adjustments to valves and regulators, checking and replenishing lubricating oil, tightening flanges and connections to eliminate leakage, rupture disc replacement, etc. Routine inspection and maintenance outlined in manufacturers literature would also be included in this category.

Gage readings and all minor maintenance performed shall be entered in a log, copies of which shall be submitted to Calgon Carbon on a periodic basis.

6.10 MAJOR MAINTENANCE

Major maintenance is that effort needed to repair or replace equipment in order to continue system operation. The need for major maintenance would result from a major malfunction causing the system to be inoperative.

Major maintenance also refers to system design changes and/or maintenance requiring downtime which would be scheduled by Calgon Carbon Corporation.

Calgon Carbon shall be contacted when any major maintenance is called for.

6.11 CALGON CARBON CONTACTS

Normal contact concerning the day-to-day operation of the system should be with the Calgon Operations Department: (412) 787-6735

OR Eastern Regional Sales Office
Bridgewater, NJ
(201) 526-4646

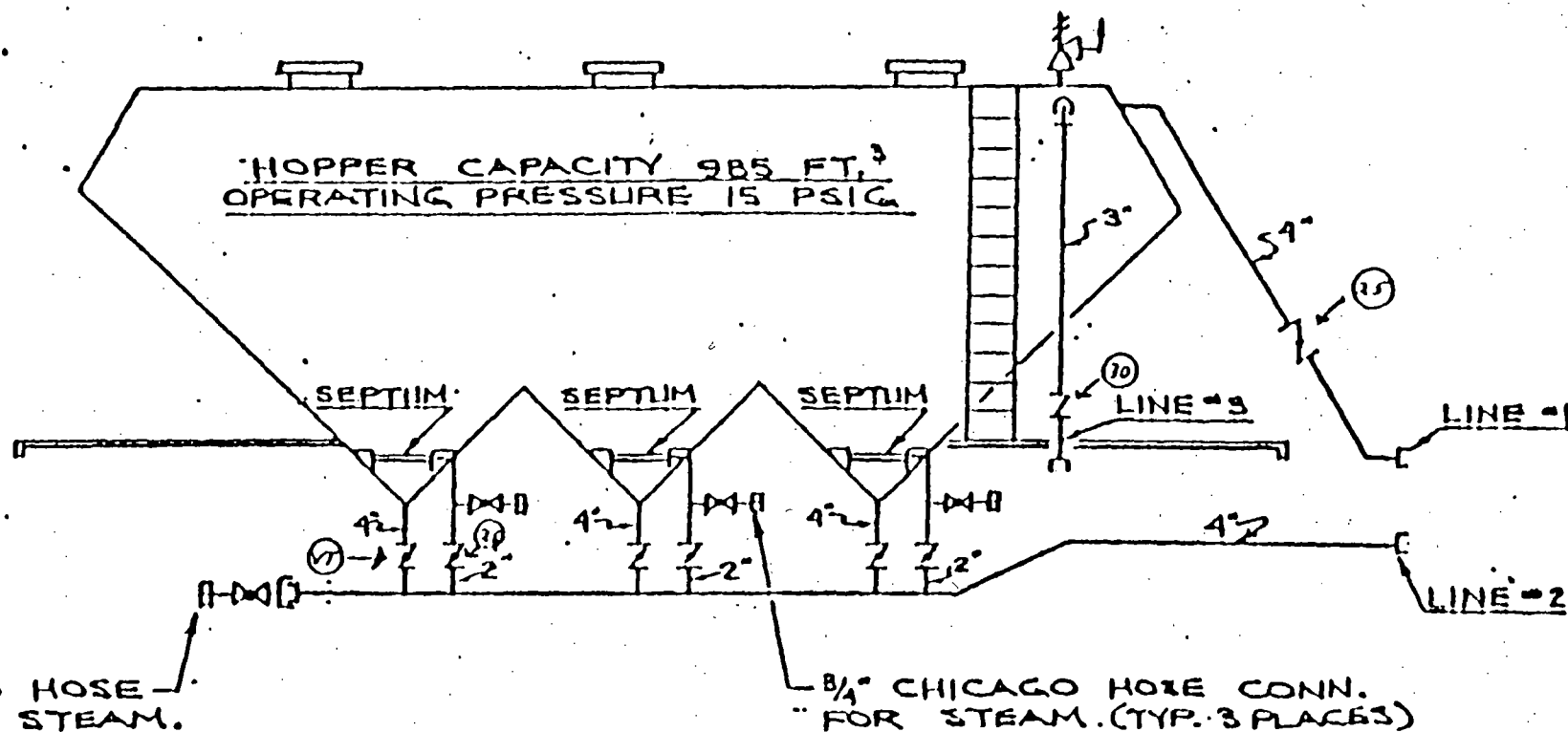
7.0 TROUBLESHOOTING

<u>Problem</u>	<u>Probable Cause</u>	<u>Remedy</u>
A. High pressure drop across adsorber.	Bed not flooded Bed is air bound	Open vent valve to release pressure. Drain bed completely then fill by adding water upflow. Make sure there is a constant flow out vent before closing the valve.
	High feed pump pressure	Throttle feed pump.
	Improper valving Suspended solids on influent	Check valve sequence. Check for obstructions in transfer lines. Test for suspended solids. Install influent filter. Backflush adsorber.
B. Leaking flange	Loose bolts	Tighten bolts.
C. Carbon in the effluent	Internal mechanical failure	To confirm, open effluent sample valve. Collect one quart effluent sample to check if carbon is present in the sample. If the above confirms mechanical failure, carbon must be removed from vessel and underdrain checked.
D. Premature breakthrough of organics, color, etc.	Change of influent concentrations	Confirm by checking influent samples before changing carbon.
	Entraining air into influent	Open vent valve to check if bed is flooded.
	Background TOC	Replace carbon.
	Leaking valves	Check operation of valves in influent and effluent lines.

7.0 TROUBLESHOOTING (Cont.)

E. Carbon in heel in emptied vessel	Insufficient spray or flush water	Increase water flow.
	Mechanical failure	Repair or change spray nozzle when present.
P. Sudden high contaminate level in effluent	Carbon heel due to improper transfer	Wait until contaminant concentration decreases. If this does not occur, replace carbon after reviewing transfer technique.
G. Frozen lines, broken gauges and valves	Cold weather	Drain stagnant piping, insulate and heat trace water, spray water, and vent lines.

FRONT



NOTE

1. LOW PRESSURE STEAM (15 PSIG OR LESS)
MAY BE USED TO THAW TRAILERS CON-
TAINING EITHER SPENT OR REACTIVATED
CARBON.

8.0 APPENDIX

**Granular Activated Carbon Products
Remove Dissolved Organic Chemicals
from Industrial and Municipal Wastewaters
Economically and Reliably**

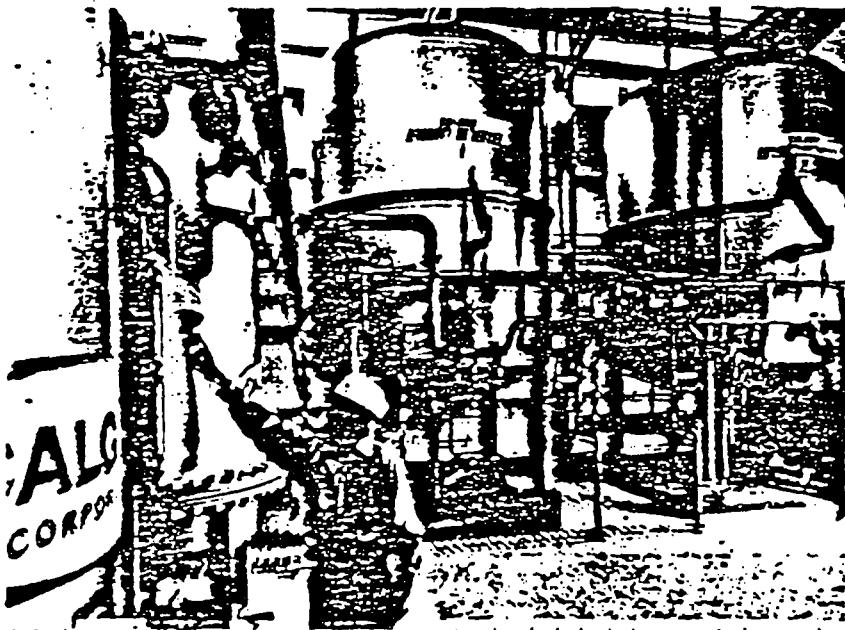
Filtrisorb 300 and 400 are two grades of granular activated carbon manufactured by Calgon Carbon Corporation for removal of organic pollutants from industrial and municipal wastewaters. These carbons are manufactured from select grades of bituminous coal to produce a high-density, high surface area, durable granular product capable of withstanding the abrasion and dynamics associated with repeated reactivation, hydraulic transport, backwashing and mechanical handling.

purposes

Filtrisorb granular activated carbons can perform a dual role of adsorbing dissolved organic contaminants from water and wastewater. Filtrisorb is effective in removing from wastewaters many dissolved toxic organic chemicals listed by the EPA as priority pollutants and hazardous substances. These include benzene, phenols, dieldrin, toluene, DDT, polychlorinated biphenyls and many others. It is also effective in removing refractory organic chemicals not responsive to biological treatment.

Industrial Water and Wastewater Treatment applications can include the following:

- Purifying incoming plant process water
- Applying point source treatment to remove chemicals
- Pre-treatment to biological waste treatment systems
- Product recovery from wastewater



A "point source" Filtrisorb adsorption system at a chemical plant cleans up toxic organics before discharging effluent. Wastes of this type can upset the effectiveness of biological-type treatment operations.

- Recycling wastewater
- Polishing effluent from biological waste treatment systems
- Providing total wastewater treatment

Municipal Wastewater Treatment applications can include the following:

- *Physical/chemical treatment* — Filtrasorb carbon is used in conjunction with water-soluble polymers. After solids settling with polymers, the effluent from the primary basin is passed through beds of Filtrasorb to filter out the remaining solids and to remove dissolved organics by adsorption.
- *Advanced wastewater treatment* — Filtrasorb can be utilized:
 - a) to polish effluent from a biological wastewater treatment system in order to remove dissolved organic chemicals which were refractory to biological treatment.
 - b) to recycle the treated water for replacement of groundwater or for other suitable recycling applications.

advantages and benefits

- *Provides ultimate disposal of pollutants* — When Filtrasorb carbon is saturated with impurities, the process of thermal reactivation destroys the impurities at very high temperatures in the reactivation furnace. This includes destruction of refractory and toxic chemicals which would otherwise be hard to destroy.

- *Economical to use* — Because of its *high surface area* and abrasion resistance, Filtrasorb can be reactivated repeatedly and returned to service to provide maximum economy.

- *Effective in treating a wide range of impurities* — Filtrasorb carbon removes hundreds of specific organic compounds from wastewaters, including many on the EPA lists of priority pollutants and hazardous substances.

These carbons are produced with an exceptionally high internal surface area of optimum pore size for adsorption of both high and low molecular weight pollutants.

- *High surface area* — Because of its numerous pores in a wide range of sizes, Filtrasorb provides a very high capacity and efficiency for removing dissolved organics. Total surface area measures approximately 950 to 1050 square meters per gram (N_2 , BET procedure).

- *Reliability* — Systems using Filtrasorb carbons accommodate changes in flow rates and increases in concentration of pollutants whether caused by spills, peak loads, pre-treatment upsets or other variations in the wastewater effluent.

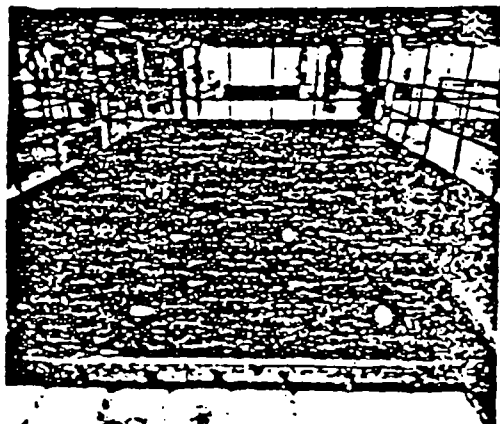
- *Suitable for backwash operations* — Filtrasorb carbons are of high density, wet readily, and do not float, thus minimizing loss during backwash operations.

For the purpose of estimating the volume of Filtrasorb in a system utilizing backwash procedures, Filtrasorb 300 has a backwashed and settled bulk density of 27-28 lbs. per cubic foot, and Filtrasorb 400 has a backwashed and settled bulk density of 26-27 lbs. per cubic foot.

reactivation

Numerous installations have demonstrated the feasibility and economy of thermal reactivation.

Exhausted granular carbon can be reactivated on your plant site in a high-temperature furnace, or it can be done by Calgon Carbon Corpo-



Because of the large volume of industrial wastes treated in this municipal plant, the use of Filtrasorb carbon provides greater reliability than a biological treatment system.

ration under a service agreement. In either case, a Calgon Carbon adsorption system specialist will assist you in comparing the economics and procedures of your reactivation options.

specifications

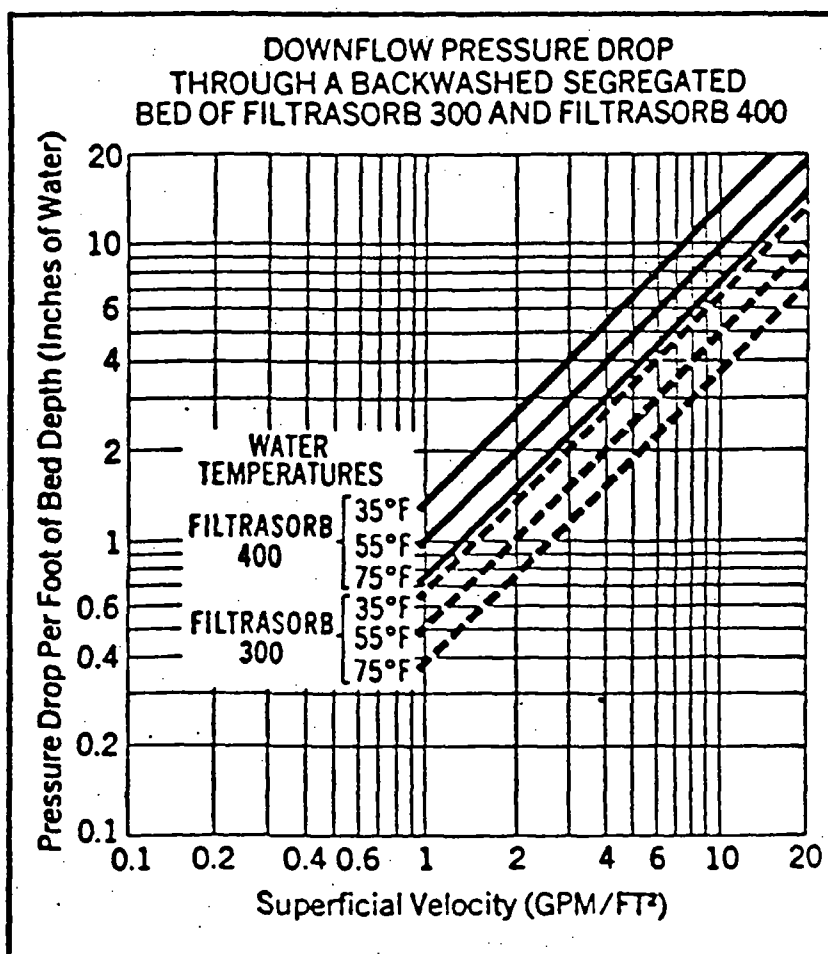
	Filtrisorb 300	Filtrisorb 400
Iodine Number (min.)	900	1000
Abrasion Number (min.)	75	75
Moisture (max.)	2.0%	2.0%
Effective Size (mm)	0.8-1.0	0.55-0.75
Water Soluble Ash (max.)	0.5%	0.5%
U. S. Standard Series Sieve Size:		
Larger than No. 8 (max.)	15%	—
Smaller than No. 30 (max.)	4%	—
Larger than No. 12 (max.)	—	5%
Smaller than No. 40 (max.)	—	4%

packaging

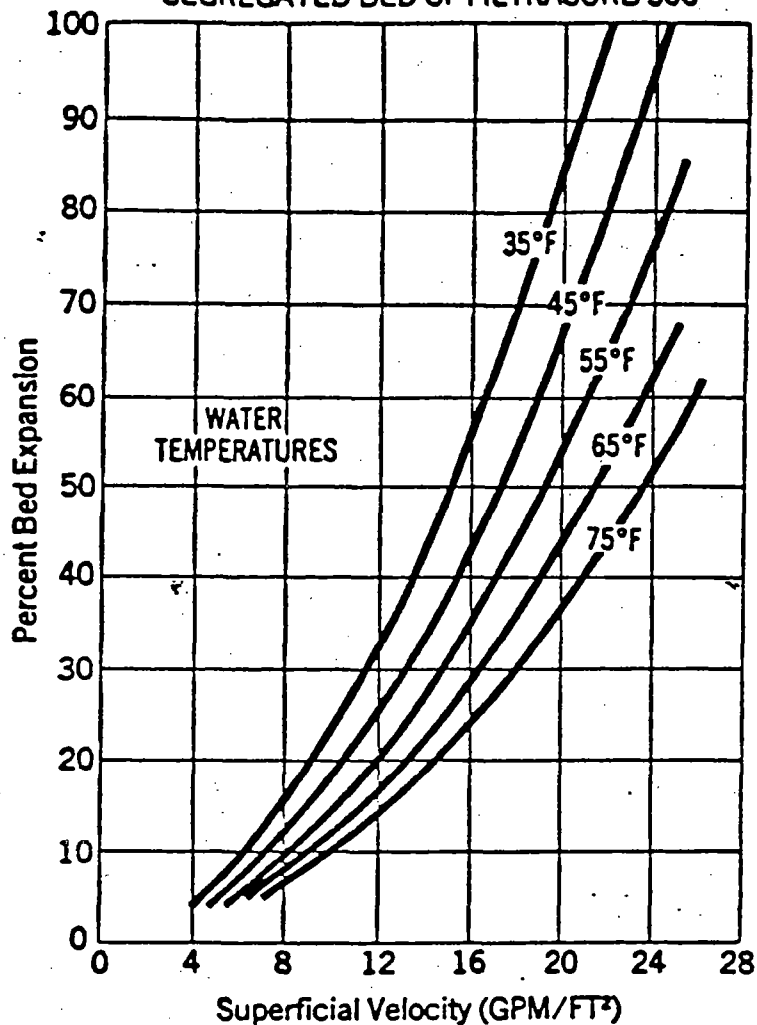
Filtrisorb can be supplied in four-ply polyethylene reinforced kraft bags 25 kg. (55.1 lbs.) net, bulk packs, or bulk shipped by rail car or truck. Shipping point: Catlettsburg, Kentucky.

caution

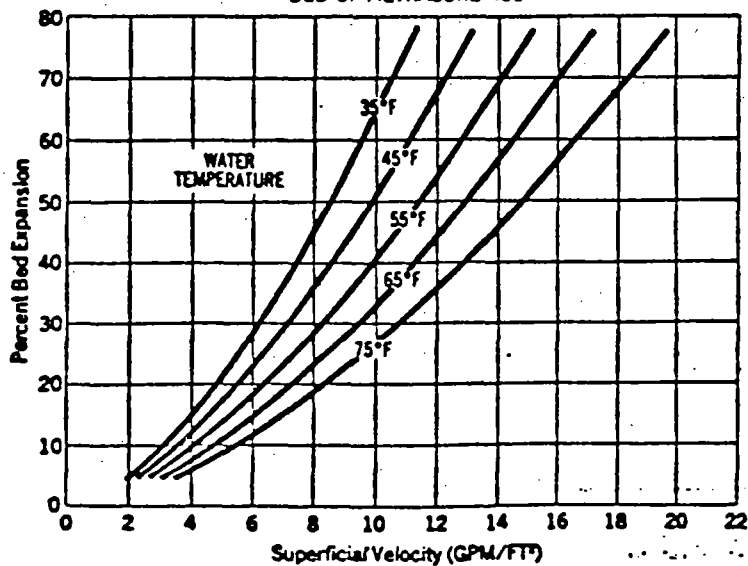
Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable Federal and State requirements.



PERCENT BED EXPANSION OF A BACKWASHED-SEGREGATED BED OF FILTRASORB 300



PERCENT BED EXPANSION OF A BACKWASHED-SEGREGATED BED OF FILTRASORB 400



For information regarding incidents involving human and environmental exposure, call (412) 787-6700 and request to speak to Regulatory and Trade Affairs.

For additional information, contact
Calgon Carbon Corporation,
P.O. Box 717, Pittsburgh, PA 15230



MATERIAL SAFETY DATA SHEET

DATE August 1985PRODUCT NAME **FILTRASORB 300
ACTIVATED CARBON**

SECTION I

MANUFACTURER'S NAME	Calgon Carbon Corporation	EMERGENCY TELEPHONE NO.	412-787-6700
ADDRESS	P.O. Box 717 Pittsburgh, PA 15230-0717		
CHEMICAL NAME AND SYNONYMS	Carbon	FORMULA	C

SECTION II HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT (S)	CAS #	% BY WEIGHT	ORAL LD ₅₀	DERMAL LD ₅₀	TLV (Units)		
					ACGIH	OSHA	OTH
Chemical Name Carbon	7440-44-0	100%	>10g/Kg* (rat)	—	N/A	N/A	N/
Common Name Activated Carbon							
Chemical Name							
Common Name							
Chemical Name							
Common Name							
Chemical Name							
Common Name							
Chemical Name							
Common Name							

*No animal mortalities during course of 14-day study.

CAUTION!! Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

This product is non-hazardous according to the definitions for "health hazard" and "physical hazard" provided in the OSHA Hazard Communication Law (29 CFR part 1910).

SECTION III PHYSICAL DATA

BOILING POINT (°F)	N/A	SPECIFIC GRAVITY (H ₂ O=1)	2.3g/cc real density
VAPOR PRESSURE (mmHg.)	N/A	PERCENT VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR=1)	N/A	pH	N/A
SOLUBILITY IN WATER	insoluble	OTHER packing density	0.4 to 0.7g/cc

APPEARANCE AND ODOR **black particulate solid**

While this information and recommendations set forth herein are believed to be accurate as of the date hereof, CALGON CARBON CORPORATION MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method Used)

N/A

EXTINGUISHING MEDIA

If involved in fire, flood with plenty of water.

SPECIAL FIRE FIGHTING PROCEDURES

None

UNUSUAL FIRE AND EXPLOSION HAZARDS

Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. may result in fire.

SECTION V HEALTH HAZARD DATA

EFFECT OF OVEREXPOSURE

A. ACUTE

1. INGESTION

The product is non-toxic through ingestion. The acute oral LD₅₀ (rat) is >10g/Kg.

2. INHALATION

The acute inhalation LC₅₀ (rat) is >64.4 mg/l (nominal concentration) for activated carbon.

3. DERMAL EXPOSURE

a. TOXIC

Non-toxic

b. IRRITATION

The product is not a primary skin irritant. The primary skin irritation index (rabbit) is 0.

c. SENSITIZATION

None

4. EYE IRRITATION

The physical nature of the product may produce eye irritation.

E. SUBCHRONIC, CHRONIC, OTHER

The effects of long-term, low-level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the avoidance of all effects from repetitive acute exposures.

F.

FIRST AID

A. EYE

Flush with plenty of water for at least 15 minutes.

B. SKIN

Wash with soap and water.

C. INGESTION

D. INHALATION

SECTION VI REACTIVITY DATA

STABILITY (Hazard to Avoid)	STABLE UNSTABLE	<input checked="" type="checkbox"/> CONDITIONS TO AVOID	None
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Strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide may be generated in the event of fire.

SECTION VII SPILL OR LEAK PROCEDURES

REPORTABLE QUANTITIES (RQ) IN LBS OF EPA HAZARDOUS SUBSTANCES IN PRODUCT	1. <u>N/A</u> 2. _____ 3. _____	NOTIFY EPA OF PRODUCT SPILLS EQUAL TO OR EXCEEDING <u>N/A</u> LBS.
--	---------------------------------------	--

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep up unused carbon and discard in refuse container or repackage.

WASTE DISPOSAL METHOD

Dispose of unused carbon in refuse container. Dispose of in accordance with local, state, and federal regulations.

SECTION VIII HANDLING & STORAGE

PROTECTIVE GLOVES Rubber gloves recommended	EYE PROTECTION Safety glasses or goggles recommended	
OTHER PROTECTIVE CLOTHING Not required		
RESPIRATORY PROTECTION A NIOSH approved particulate filter respirator is recommended if excessive dust is generated.		
VENTILATION	LOCAL EXHAUST Recommended	OTHER
	MECHANICAL (General) Recommended	

STORAGE & HANDLING

CAUTION!! Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

SAFETY PRECAUTIONS

Wash thoroughly after handling. Exercise caution in the storage and handling of all chemical substances.

TECHNICAL INFORMATION BULLETIN

SUBJECTS: 1) Oxygen Demand Created by Activated Carbon in Confined Vessels
2) Hazards with Certain Process Conditions
3) Need for Grounding of Carbon Systems



SUBSIDIARY OF MERCK & CO. INC.

1. Oxygen Demand Created by Activated Carbon in Confined Vessels

It has been confirmed that wet granular activated carbon confined in large vessels creates an oxygen demand which is hazardous to human health and can cause death unless proper safety precautions are observed. Investigation of this matter was prompted by an accident which occurred on a project in which a granular activated carbon system was being installed.

Studies conducted in vessels similar to that in which the accident occurred have shown that *low oxygen content exists* in vessels containing wet carbon. Laboratory experiments conducted since that time also have revealed that commercial activated carbons in a wet or moist condition — including Filtrasorb and Pittsburgh grades — will lower the oxygen content of an isolated space. Preliminary indications of this research are:

- a. The phenomenon occurs with wet activated carbon of all common types.
- b. The rate of oxygen uptake naturally varies with the degree of exposure of the wet carbon to the air. Thus it is relatively rapid in a drained bed.
- c. There is some indication of a limit to carbon's capacity for oxygen, but until more is known, it would be prudent to assume that all carbon (fresh, used, reactivated) will also exhibit this characteristic. Similarly, although these tests were run with water, it should be assumed that the phenomenon will occur in other liquid and vapor systems.

All confined spaces, including those containing activated carbon, should be presumed to be hazardous. Appropriate safety measures should always be taken before entering, as well as when workers are in, a confined space. OSHA regulations applicable to respiratory protection in oxygen-deficient atmospheres should be strictly adhered to.

2. Hazards with Certain Process Conditions

Under certain process conditions, activated carbons may show an affinity for atmospheric oxygen or may interact with process streams to generate potentially toxic or hazardous levels of hydrogen sulfide, methane, ethanol, carbon dioxide and other gases. These effects can become pronounced in a relatively confined space, such as the headspace of an adsorber. Should entry to confined spaces containing activated carbon become necessary, appropriate ventilation and other safety practices for potentially flammable, toxic or oxygen-deficient environments should be followed.

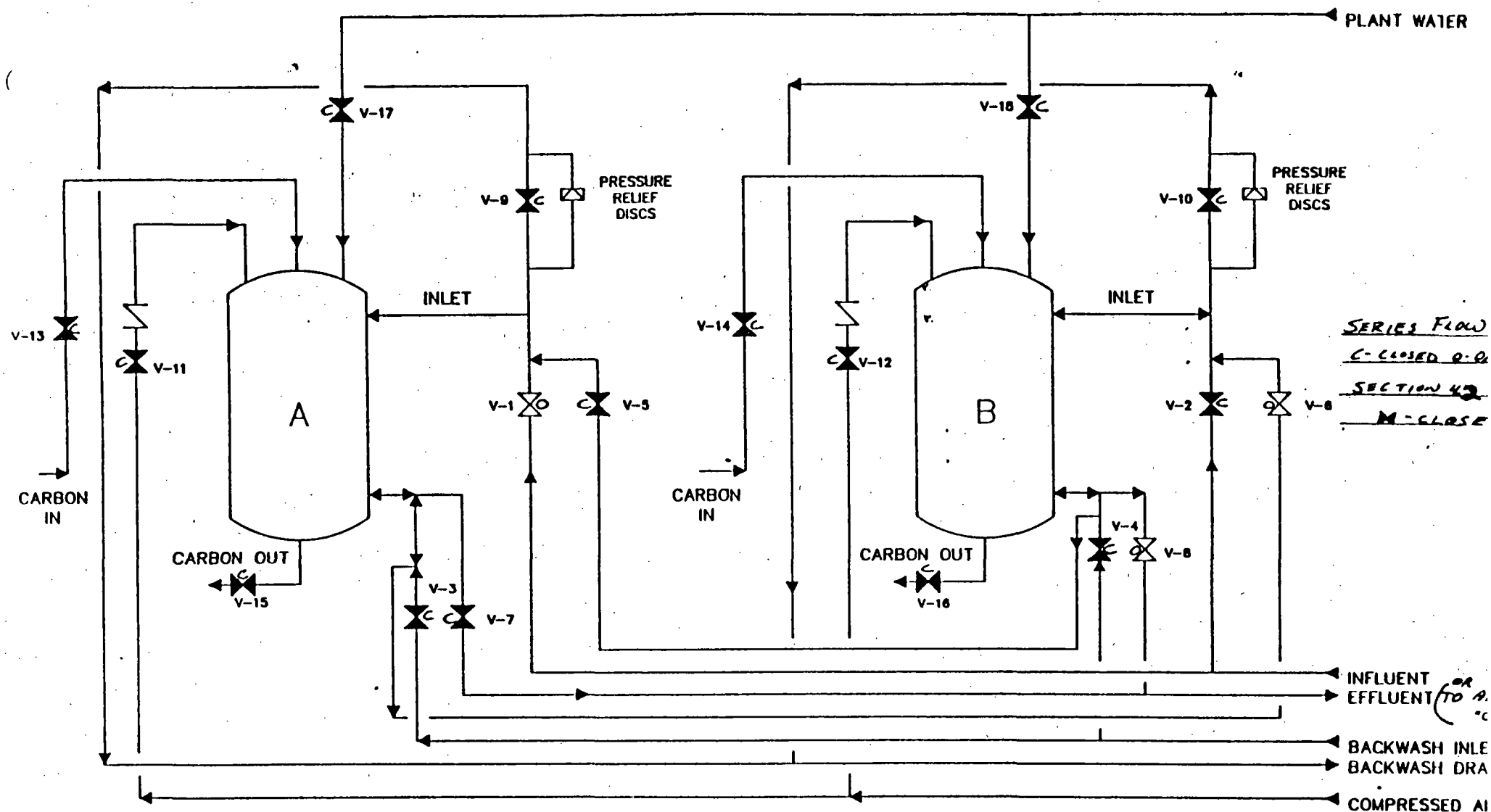
To avoid possible combustion of the carbon or the material being adsorbed, caution is recommended in contacting activated carbon with strong oxidizing agents, such as chlorine. Use with liquid oxygen and ozone is discouraged.

3. Need for Grounding of Carbon Systems

In certain systems, high voltage static electrical charges may accumulate to levels of shock or ignition hazard. As a precaution against possible ignition or shock, all carbon treatment systems should be adequately grounded.

CALGON CORPORATION, P. O. BOX 1346, PITTSBURGH, PA. 15230

Printed in U.S.A.

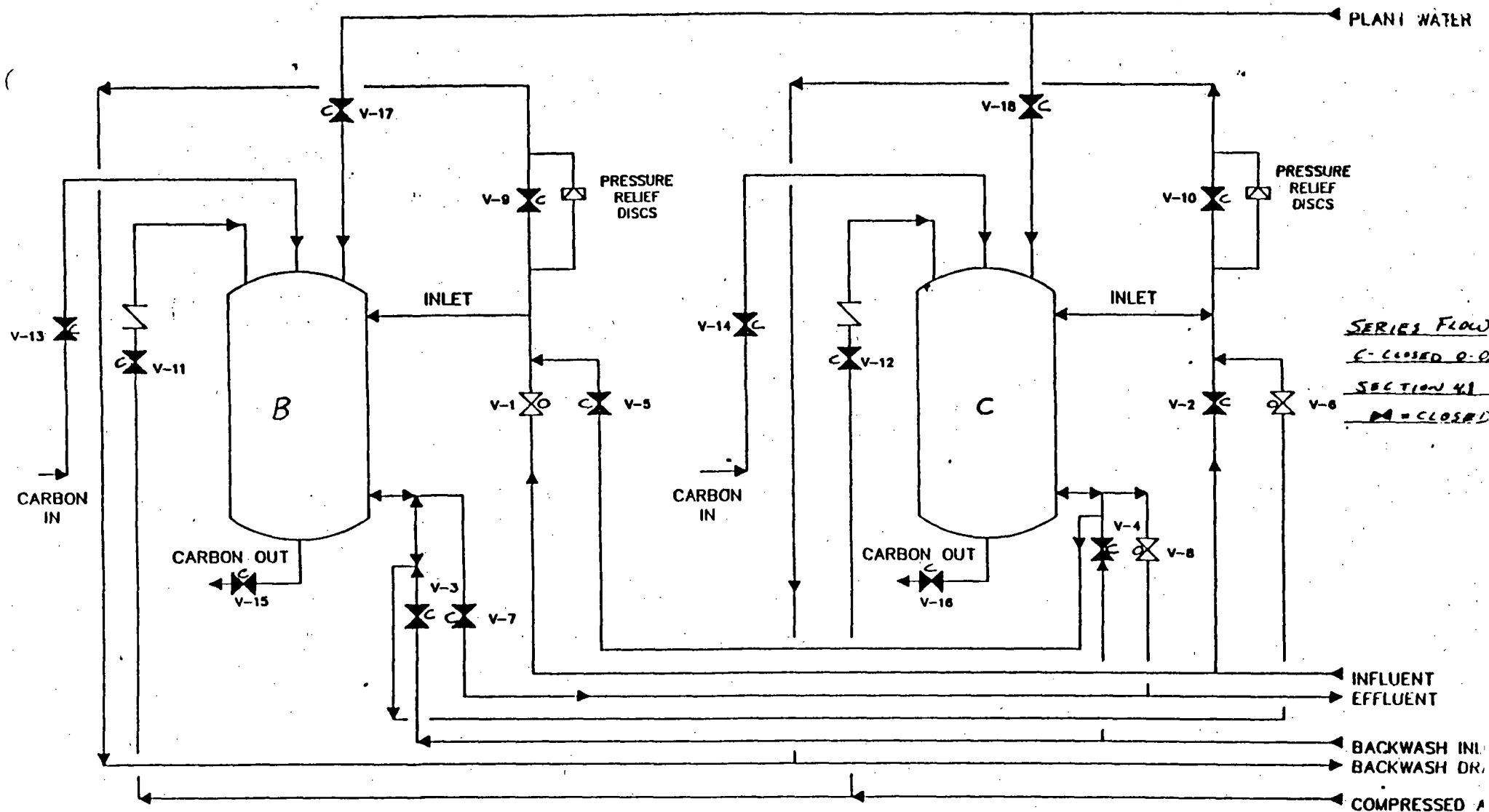


PROJECT _____
 SCALE _____
 DRAWN W.E. _____
 DATE 6 - 16 - 88
 CHK'D G.H.C.
 APPR'D G.H.C.



CALGON CARBON CORPORATION
 P.O. BOX 717 PITTSBURGH, PA 15230-0717

TITLE BACKWASH MODEL
 7.5
 DWG NO. SK61688



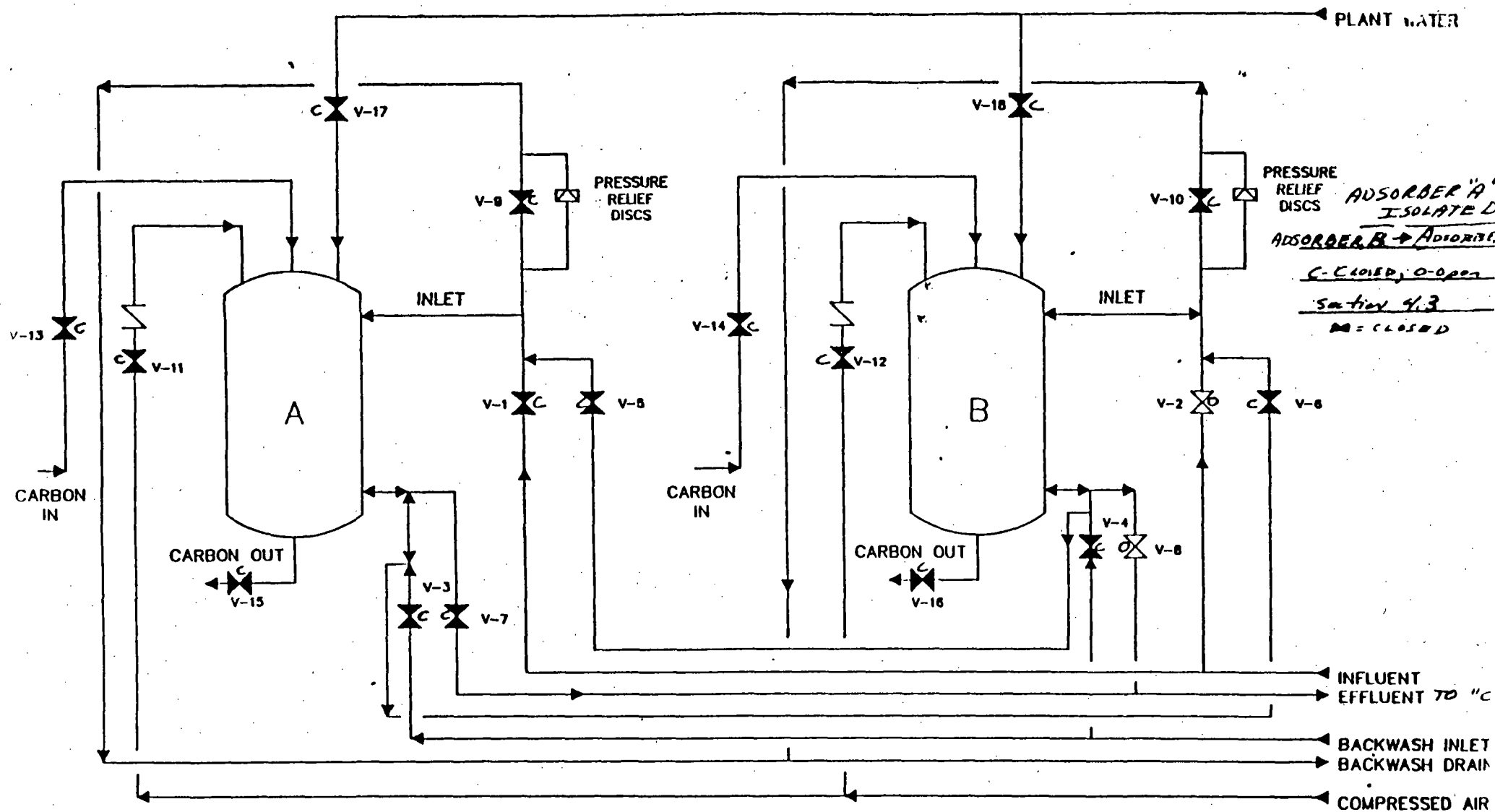
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 SCALE _____
 DRAWN W.F. _____
 DATE 6 - 16 - 88
 CHK'D C.H.G.
 APPR'D C.H.G.



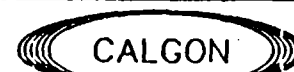
CALGON CARBON CORPORATION
 P.O. BOX 717 PITTSBURGH, PA 15230-0717

TITLE BACKWASH MODEL
 7.5

DWG NO. SK61688



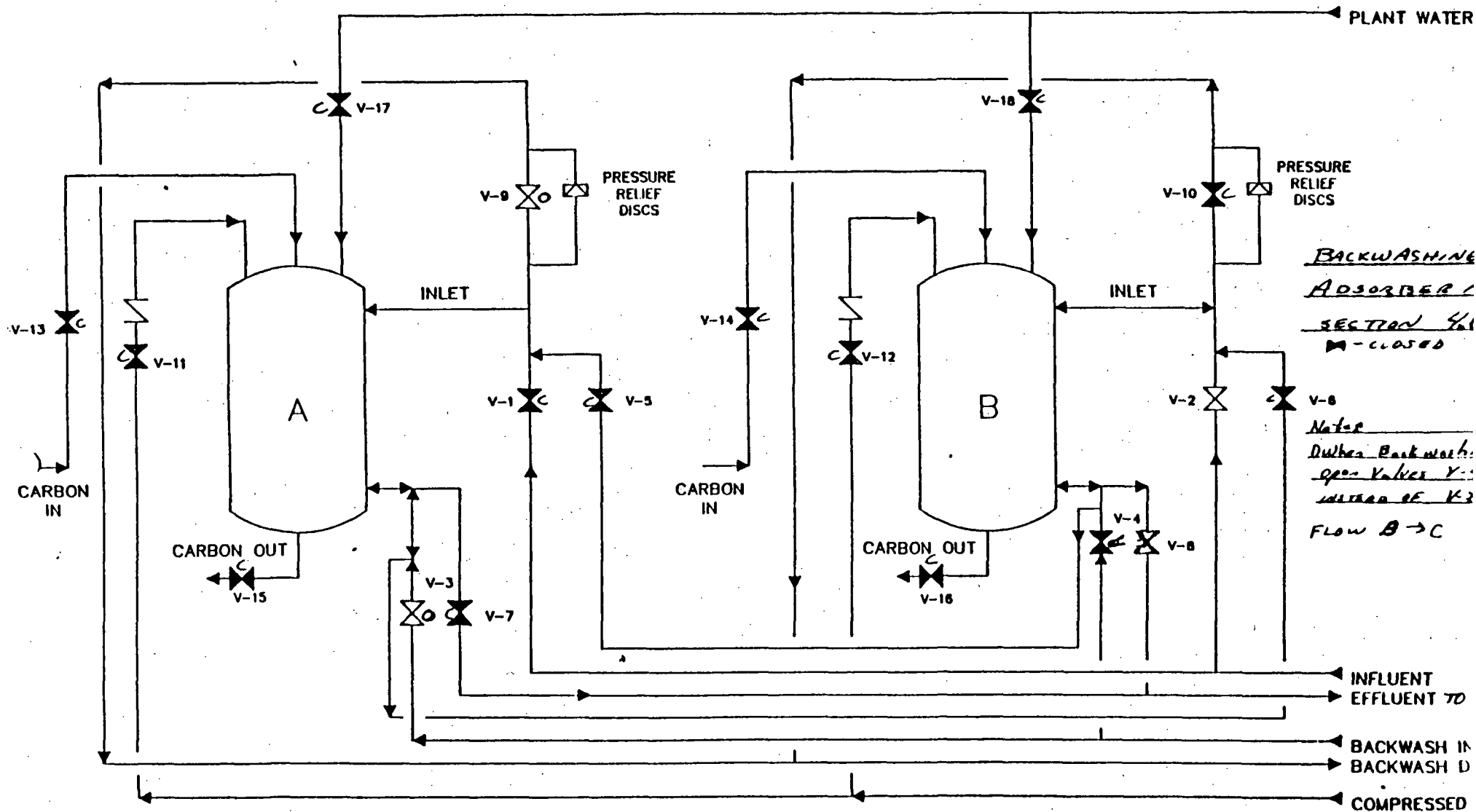
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 SCALE _____
 DRAWN W.E. _____
 DATE 6 - 16 - 88
 CHK'D G.H.G.
 APPR'D G.H.G.



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 P.O. BOX 717 PITTSBURGH, PA 15231-0717

TITLE BACKWASH MODEL
 7.5

DWG. NO. SK61688



PROJECT _____
 SCALE _____
 DRAWN W.E. _____
 DATE 6 - 18 - 88
 CHK'D C.H.G.
 APPR'D C.H.G.



CALGON CARBON CORPORATION
 P.O. BOX 717 PITTSBURGH, PA 15230-0717

TITLE **BACKWASH MODEL 7.5**
 DWG. NO. **SK61688**